

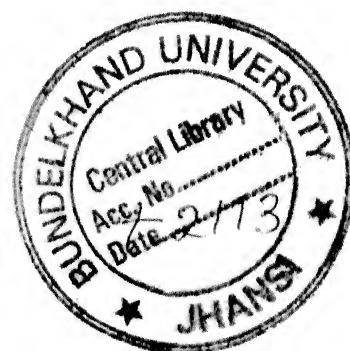
A STUDY ON ACCEPTANCE AND CONSTRAINTS OF NON-CONVENTIONAL ENERGY DEVICES USED BY RURAL HOUSEHOLDS

THESIS

**Submitted to the
Faculty of Home Science,
Bundelkhand University, Jhansi**



**for the award of
the Degree of
Doctor of Philosophy
in
Home Science**



2006

By

Miss Nidhi Tiwari

Supervisor:

Dr. Veena Nigam

Head, Department of Home Science
Juhari Devi Post Graduate Girls College
Kanpur

Co-Supervisor:

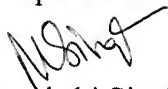
Dr. Meenakshi Singh

Lecturer, HDFSI, Institute of H.Sc
Bundelkhand University,
Jhansi

CERTIFICATE

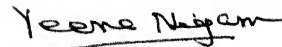
We the undersigned members are the Chairman and Co-Chairman of the Advisory Committee of **Miss Nidhi Tiwari**, a candidate for the degree of Doctor of Philosophy in Home Science agree that the thesis entitled "**A Study on Acceptance and Constraints of Non-Conventional Energy Devices Used by Rural House Holds**", may be submitted by her in partial fulfillment of the requirement for the degree.

Co-Supervisor



(Dr. Meenakshi Singh)
Lecturer, HDFS, Institute of H.Sc.,
Bundelkhand University, Jhansi

Supervisor



(Dr. Veena Nigam)
Head, Department of H.Sc., Juhari Devi
Post Graduate Girls College, Kanpur

ACKNOWLEDGEMENT

It is my proud privilege and great opportunity to work under an inspiring guidance, a persistent encouragement and constructive criticism of Dr. Veena Nigam, Lecturer, Juhari Devi Girls PG College, Kanpur and Chairman of my research work. I am extremely indebted to her for being meticulous throughout the investigation and preparation of this manuscript. I sought keen interest, valuable suggestions and constant inspiration of my Co-Guide Dr. Meenakshi Singh, Lecturer, HDFS, Institute of Home Science, Bundelkhand University, Jhansi. I am highly obliged and can never forget the help rendered by them during the course of my investigation.

I also express my deep sense of gratitude to Mr. Arun Kumar Srivastava, Assistant Statistician, Department of Crop Physiology, CSAUA&T, Kanpur for rendering his help in statistical analysis of the research data.

Words are very few to express the real concern, love, encouragement and inspiration that my Papaji, Mr. Shiv Prasad Tiwari and Mummiji Mrs. Prem Lata Tiwari showered on me without which I could not have done anything. My whole family members, my younger brother Gaurav Kumar Tiwari and younger sister Vidhi Tiwari have always boosted up my morale and encouraged me much to carry out the research work in adverse condition too.

By saying merely thanks, I do not want to reduce the love, affection and inspiration and moral support of my husband and best friend Vivek Dixit whose untiring help gave me every time a ray of hope in the darkness of problem, animated to overcome and face them with smile, and a thanks to my Father-in-Law Dr. R. P. Dixit and Mother-in-Law Mrs. Chandra Kala Dixit for good wishes on this work.

My special thanks for those who knowingly or unknowingly helped me through their constructive criticism and suggestions from time to time which inspired me to do my best all the times.

I am very thankful to Sri A. K. S. Sengar, Office Secretary, Registrar Office, CSAUA&T, Kanpur for their help during the preparation of this manuscript.

Before to pen down, I confess that I don't know how to acknowledge the help and cooperation of my guide, Co-guide, family members, husband friends but above feelings are followed from the origin of my heart in the shape of words and as gospel truth.

Dated:

Place:

Nidhi Tiwari

(Nidhi Tiwari)

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Introduction

Chapter-I

INTRODUCTION

“Non-conventional Energy is fast catching the imagination of the people in our country. By tapping the unending and environmentally friendly renewable energy sources, we can move towards energy-sufficiency, security, stability and sustainability”

The present day civilization can be termed as a civilization whose life style is so ingrained in unprecedented use of varied forms of energy unknown in the annals of human history. Use of wood, charcoal, minerals coal, fossil fuels and now atomic energy, even at the risk of radiation and other dangers involved in the case had their way and now we come across a peculiar situation when the civilization has reached the dead end of its growth oriented living. During the last decade elaborate thinking and worldwide consciousness questioned the very idea of development and the limits to growth became more pronounced calling for a halt to the rat-race for exploitation of exhaustible energy resources and annihilation of all living beings on this planet caused by widespread pollution (Taori, 1992).

Energy is the most fundamental requirement in every sphere of life. Perhaps after food, energy is the most important component for economic development of a country and for improving the quality of life of the people. With the advancement in Science and Technology and industrial development, the need of energy has increased manifold all over the world. This is more so in developing countries like India. Energy crisis has reached a critical stage in rural

India, for the simple reason that the conventional energy reserves are finite. Coal, oil, wood and kerosene are becoming scarce and expensive day by day. As a consequence, poor people of rural India are most affected.

One of the most important tasks of the planning process is to ensure sharp increase in production of energy. The development of energy source is highly capital intensive as a result of which the energy sector outlays in the VII and VIII plans in India are about 30 per cent of the total plan outlays. In spite of such large investments, there is a growing shortage of energy in all sectors of our economy. In fact, the per capita energy consumption in India is still one of the lowest in the world. Furthermore, 80 per cent of the total energy are being consumed by urban areas with only 20 per cent of the population and rural areas consume 20 per cent with 80 per cent of the population (Srivastava, 1995).

Of the total commercial energy produced in the form of power or electricity, about 69 per cent comes from coal or thermal power, 4 per cent from diesel and gas and less than 1.0 per cent from non-conventional sources (solar, wind, biogas, mini hydel, etc.). Besides the commercial energy sources noted above, nearly 50 per cent of the total energy requirement in the country, particularly in the entire rural areas and in significant sections of the urban areas is met by wood, agriculture waste and animal dung (Srivastava, 1995).

It was in the last decade that a search for such energy resources which are clean and can be renewed and even can prove inexhaustible to the yearning appetite of the modern man started in developing and developed countries alike. And it was not all in vain. The human ingenuity and its perceiving imagination seems to succeed against all darkness as such sources had not only been identified but persistent research and development have paved way for evolving technology to exploit abandoned energy resources like sea waves, wind, sunlight

and biomass which can be fruitfully utilized at present for day to day human need and a variety of other uses to the human race, at least as a supplement energy source.

Among the conventional sources of the energy production, there is not even one source, which is free from environmental implications. The hydroelectric power projects are associated with displacement of a large human population leading to considerable human problems. Even the non-commercial sources of power like burning of wood, etc., are causing threat to our forest resource and ultimately the environmental degradation.

The only pollution free sources of energy production come from the non-conventional sectors such as solar, wind, tidal, ocean waves, etc., which are renewable. This is going to be the most important sector for all developing countries in future. The importance of non-conventional sources of energy in the context of rural development in India cannot be overemphasised. It is also important for us in view of the overall scarcity of fossil fuels. Cost of transportation of conventional fuel in a widely stretched country, particularly in rural areas as also for long term sustainable development.

The problems of population explosion, environmental degradation and fast depleting reserves of fossil fuels have necessitated to think about non-conventional sources of energy. Apart from expanding conventional sources viz., hydro, coal, nuclear energy and oil, a major effort is needed to expand energy supply from non-conventional sources like solar, wind, biomass and biogas.

The Government has been making tremendous efforts in this direction. The development and utilization of new and renewable sources of energy opens up the prospect of increasing indigenous energy supply and thereby contributing to greater self-sufficiency. Their development creates new options to respond to

the energy requirements of the rural, industrial, transport and other domestic sectors, in accordance with national goals and priorities and provides for a more diversified and decentralized pattern of energy supply. Thus, the role of the non-conventional sources of energy can be perceived as a dynamic interaction between resources, technologies and present and future requirements of energy, all serving national objectives for economic and social development.

Non-conventional energy sources are those which are not used in a customary fashion by the users. For instance, use of solar energy has been there since the existence of life on the earth but use of solar energy through alternative devices like solar plates, heater or cooker conceptualize it as non-conventional source of energy. Similarly, use of the firewood in traditional mud stoves is conventional in nature whereas its use through improved stoves may make it to conceptualize as non-conventional. The idea of non-conventional energy sources got momentum with the formation of energy conservation policies to meet the critical energy crisis situation for different sectors of the society. Non-conventional energy sources are also called as renewable energy sources or alternate energy sources.

The planners and policy makers at the national level are concentrating their efforts for promotion of alternate energy technologies through establishment of various departments and organization viz., Non-conventional Energy Source (NES), Commission for Additional Source of Energy (CASE), Indian Renewable Energy Development Agency (IREDA), Department of Science and Technology (DST), etc. Several energy intervention programmes like Integrated Rural Energy Programme (IREP), National Programme on Improved Chulhas, National Project on Biogas Development, Solar Energy Programme, Urjagram Programme, etc. have been launched to conserve the

biomass at the domestic sector. As a result, considerable progress has been made during the last few years in the research and extension activities in the area of non-conventional sources. It is well known fact that the coal and oil resources are scarce and the hydel power projects require huge investments and include long gestation period and with chronic shortage of funds it is not an easy task for India to utilize the energy resources like solar and nuclear fusion though they are abundant.

Hence, the non-commercial energy like biogas seems to be the ultimate reserved answer to the energy crisis at present. Being predominantly a rural country and containing large cattle population and an agricultural base this country has sizable biogas potential which can be harnessed to meet the energy needs especially of rural areas.

Approximately 95 per cent of the cooking fuel requirements of Indian rural people is met from the non-commercial sources like firewood, dung cakes and farm wastes. However, livestock produces sufficient wet dung per year to be equivalent to 16 Mt of firewood and 428.7 Mt of organic manure. One-third of dung is burnt in rural areas as fuel, but, by popularizing gobar gas plant, burning can become much more efficient (Patel *et al.*, 1993).

The cattle population including buffaloes in India is about 271 million. Assuming the average wet dung obtained per animal per day to be 10 kg and a collection rate of 66 per cent, the total availability of wet dung in the country would be 655 million tones per annum. This would itself enable the production of 25,545 million cubic metres of gas which can replace kerosene oil to an extent of 15,840 million litres per year. Out of the total dung produced today, over 35 per cent is burnt in the form of cattle dung cakes. If all the cattle dung produced could be converted to gobar gas and manure, the country's supply of organic

manure will increase by 130 million tonnes. At the rate of 25 tonnes per hectare this may suffice for 5.2 million hectares of agricultural land (Tiwari, 1998).

India is a country with numerically dominant rural population where its villages inhabit about 70 per cent of its human resources, and hence the development of the country as a whole is intimately related with the rural development in this context, energy is needed for various end uses like cooking, heating, lighting, water pumping and various agricultural operations.

About 40 per cent of the total energy consumed in the country is in rural areas of which domestic sector is the major sector of energy demand and consumption accounting for 55-60 per cent of the total energy use. The major portion of energy demand in these areas for cooking and heating is met through the locally available non-commercial energy sources (like firewood, cow dung and agricultural residues (Rao, 1977; Mathew, 1978; Pant, 1978; Patil, 1980; Reddy, 1982 and Yadav, 1988).

Most unfortunately these energy resources have become scarce because of phenomenal growth in the population of our country as well as the devastating exploitation of natural wealth. The rural areas, at present, suffer from inadequate supply of commercial energy, which too is dwindling very fast. Besides, constraints of meager availability, inefficient management and unscientific utilization of energy sources are inflicting deleterious environmental pollution and consequently various dreaded health hazards.

Though all the energy consuming segments are important yet the household sector particularly in rural areas is exceedingly important due to scarcity of fuels for various operation. Use of cow dung for cooking purpose in the form of dung cakes causing severe loss of plant nutrients, deforestation to a critical stage when firewood is not available in required quantity and used in low

efficient mud stoves are the consequent effect of conventional energy use pattern. Under these circumstances, the non-conventional energy sources have come to occupy an important place in the scheme of things. But the use of these energy resources by the actual users is still a challenging and difficult task.

Non-conventional energy is eminently suited for meeting the basic energy needs of rural households. Traditionally, rural household have been dependent upon biomass fuels. Greater responsibility for women and children in gathering these fuels, low efficiencies of usage, deforestation, increasing drudgery and its adverse impact on the health of the women are the unfortunate features of the scenario. The household energy use pattern show that most energy is utilized for basic survival tasks such as cooking, cleaning, fetching fuel, water and other necessities of life. Commercial energy, which accounts for 6.5 per cent of the total energy consumption of household is used exclusively for lighting (Dendukari and Mittal, 1993).

It was found that firewood accounted to over 80 per cent of the total energy resources in the village and that 96 per cent of this resource was consumed domestically, 82 per cent for cooking and 14 per cent for heating water. Cooking accounted for 2.48 human hours per day and a woman contributed 2.28 hours on an average per day per household. Thus, the rural woman is more affected by the energy crisis (Verma, 1991).

Indian village woman inhales daily cancer causing smoke with benzo-a-pyrene equivalent to smoking twenty packets of cigarettes everyday while cooking food by burning of cattle dung cakes, wood and other fuels cheaply and readily available in rural areas. To collect firewood for cooking as much as 50-200 work days of an individual per family per year are lost. Denuding of forests

is a result of this extensive search of wood required for cooking (Bhatnagar *et al.*, 1990).

If India, sustains its current rate of firewood consumption – 141.4 million tonnes a year – by the year 2000, 250 million people in India will not be able to cook their food as Parameswaran, 1991 reports.

Rural areas with cattle population and farms generate huge amount of materials like crop residue and animal wastes which could be converted into usable source of energy. On the other hand, there is also the need to find out way and means of reducing the work load of rural women in household activities which will enable them to devote more time in productive activities and in bringing up their own children.

“The strategy of the Government has, therefore, been to promote indigenously developed biogas technology for recycling of animal waste and a variety of improved chulhas for conserving firewood and other biomass fuels” (Annual Report, 1995-96, MNES).

Biogas plant is actually economically profitable besides it is hygienic in operation as there is no smoke and soot. Biogas is considered the most important renewable energy source for villagers. The massive programme of biogas plant installation is taken up throughout the country over 10 lakh biogas plants have been set up so far in the country. India is now world's second largest owner of biogas plants (Digraskar *et al.*, 1992).

One of the basic factors for acceptance of the new technology is its profitability over the prevailing one. It was observed that except kerosene all other fuels are costly when compared with gobar gas. It was also revealed that dung cake which has minimum calorific value is the costliest fuel followed by electricity revealing that it is a crime to use dung cake as fuel. Even wood is

costlier than gobar gas. Only kerosene has an edge over gas which is marginal and hence can not be relied upon since there is escalation in the price of kerosene (Pathak, 1985).

The manifold benefits which accrue due to biogas plants are recognized variably at the national and individual levels. It has more relevance to the nation in terms of environment and sanitation improvement, reduction of deforestation, etc., but these considerations do not influence the individuals to adopt the technology.

In India, the research and experimentation on biogas began at Indian Agricultural Research Institute in 1939. Mr. J.J. Patel developed a design called as "Gram Laxmi-I" in 1951. Later on, it was improvised frequently and in the year 1979 a modified and perfect technology popularly known as "Janata Biogas" plant was recommended for Indian ruralities.

The Ministry of Agriculture, Government of India, had undertaken gobar gas programme on large scale with the provision of subsidy since the last two five year plans. Various institutions and agencies have made their efforts to popularise this technology for solving the problem of fuel as well as manure. In spite of these efforts the adoption level of gobar gas plant is quite uneven in various parts of the country due to some or other difficulties experienced by most of the farmers who could not adopt the technology. All innovations may not be adopted by the people in a social system. Non-adoption of biogas plant may be due to various constraints which may be further aggravated due to the individual's attitude towards acceptance of gobar gas technology, individual's knowledge of the technology, various other socio-personal, economic, communicational and psychological factors.

Improved technologies are the product of modern science and technology. Development of new technologies is not generally the major problem now-a-days in most of developing countries. The main problem as it exists today is that of acceptance of these technologies by the intended beneficiaries. Rogers (1962) stressed that a decision to adopt an innovation is one of the special type of decision making process.

Unfortunately biogas technology is not successful to the desired extent. Despite the bright prospects, the response of the people so far have been poor. The rationale may be low knowledge level and the negative attitude of the rural public towards this technology both of which contributing to low acceptance level of this technology.

A technology can be said to be successfully implemented in a rural area only when the people have accepted and adopted it after having a greater knowledge of different aspects of the technology and having a positive attitude towards it.

A large number of people in rural areas still light their homes with oil lamps and cook by burning cow dung cakes and dried twigs. These people hardly use any petroleum product. Yet the energy crisis has hit them the hardest. So, also the shortage, timely supplies and the price hikes of fertilizers have created a difficult situation for poor farmers. Moreover, it is the opinion of agricultural experts that fertilizer in itself is not adequate for cultivation, the soil must be supplied with organic manure along with fertilizers. Organic manure in the form of cow dung has been traditionally used by farmers.

The introduction and utilization of every technologies in rural areas should not only bring about physical improvements but should also exert positive influence on their mental set, i.e., increased knowledge and positive

attitude and acceptance so as to increase their potential to better them to compete in advancement with the outside world.

Our basic problem in rural energy is not just to provide one form of energy or another on an adhoc basis but to build an energy infrastructure which will help to meet the essential needs, create employment opportunities, improve environment, education, welfare and sanitary conditions, provide education, entertainment or in other words total transformation of human resources through the advancement of community in the process of its own uplift.

As the main objective of rural energy technologies is to improve the quality of life. For self-development, adequate know-how/knowledge about new technologies, changed attitude and readiness to accept/adopt the technologies is essential which would help rural women to perceive the attached benefits of energy technologies.

With these ends in view, the study has been designed with the following specific objectives.

1. To study the socio-economic profile of the respondents and households.
2. To assess the perception of rural families about applicability of not conventional energy sources.
3. To assess the attitude of rural families in acceptance of non-conventional energy devices.
4. To identify the constraints in acceptance of non-conventional energy devices by rural families.

5. To suggest the suitable measures for removal of constraints faced by rural families in acceptance of non-conventional energy devices.

Scope of the study

It is expected that the findings of this study would provide guidelines for the governmental and non-governmental agencies working for biogas development programmes more effectively. The study highlighted the major constraints which block the effective installation and functioning of the biogas plant. The study also pinpointed the difficulties which arise after installation of the plant and ultimately result into the failure of the biogas programme. This would provide a strategical plan to the agencies before introducing the biogas technology in the village conditions. Contributory factors for the acceptance and adoption of biogas technology were also identified, which should be taken care of by the implementing agencies and agencies involved in transfer of technology.

An attitudinal scale to measure the acceptance level of biogas technologies was also developed based upon the responses of experts and academicians, which can be used by future researcher working in this field.

Limitation of the Study

The present study had its own limitation as regards sample, study area, time and other research facilities usually confronted by a single student researcher. The study was confined to twelve villages of Fatehpur district of U.P. state. Thus, the findings of the study limit themselves to generalization and application on larger population, but they are illustrative for villages with similar conditions.

Review of Literature

Chapter-II

REVIEW OF LITERATURE

An attempt has been made here to present a brief resume of the available literature on the issues relevant to the study under the following sub-sections :

Objectives

1. To study the socio-economic profile of the respondents and households.
2. To assess the perception of rural families about applicability of non-conventional energy sources.
3. To assess the attitude of rural families in acceptance of non-conventional energy devices.
4. To identify the constraints in acceptance of non-conventional energy devices by rural families.
5. To suggest the suitable measures for removal of constraints faced by rural families in acceptance of non-conventional energy devices.

Swaminathan (1981) opined that use of biogas not only supplements energy production but also helps conserving organic manure which is otherwise burnt for fuel.

Krishna *et al.* (1981) concluded that there is awareness of the utility of biogas in the villages. The biogas technology in its present form can be owned by those people who have financial and other resources including agricultural land and minimum three cattle.

Gowda *et al.* (1981) reported that 52.8 per cent of non-adopters perceived the use of gobar gas plant was to get good manure followed by 29.1 per cent

who indicated that gobar gas plant was to get light and to use for cooking while 41.9 per cent of the non-adopters perceived that use of gobar gas plants solve the fuel problem. Therefore, all non-adopters have not perceived all the real use of gobar gas plant.

Meena (1984) said that utilization of solar energy can improve the quality of life in our villages by providing cooking, water pumping and crop drying facilities at minimum cost. The applications of solar energy for villages are cooking, lighting, water pumping, purification of brackish or saline water, refrigeration water or space heating in cold in cold or hilly regions, production of salt from sea water and small scale electricity generation.

Pathak (1984) reported that the programme on renewable sources of energy in India covered solar, wind, biomass, chemical and geothermal energy and their application to agriculture, transportation and domestic sectors.

Rahman Matiyar (1985) reported that in village Masudpur having about 162 families and a total population of 1200, about 60 tonnes had got the connection of community gobar gas plant and are benefiting from this plant in more ways than one. The community latrines attached to the biogas plant, not only helped the village produce additional quantity of manure but also improve rural sanitation.

Natarajan (1985) revealed that rural women lacked awareness of the possible advantages form the use of superior fuels. Where they were aware of the advantage, they preferred them.

Lavasa (1985) also indicated the main reasons for failure of biogas plants as the leakage in gas holder, collapsing of partition wall of digester, defects in the inlet and outlet due to choaking, broken gate values with defects in pipelines, damage due to flood and temporary rise of water table in some areas, lack of

training to the farmers in maintenance and lack of trained staff to repair and educate the farmers.

Grover and Sangwan (1987) reported the advantages of new and renewable source of energy that these energy sources are practically inexhaustible and easily available and suited to the human environment. The main sources of this form of energy, useful for the home and community, include the solar cooker, smokeless chulha, biogas, solar water heater, solar crop dryer, solar photovoltaic water pumps and wind energy.

Yashwant (1987) found that the women folk expressed their positive reaction towards biogas as this technology has considerably changed their cooking habits from time consuming, smoky and monotonous to that of quick clean and interesting. Moreover, the utensils were easy to clean and keep them strick and span. It was also informed that within four to five hours time in a day, it was possible for the respondents to complete the cooking.

Singh (1987) noted that the most important constraints experienced by users in order of importance and magnitude in descending order included lack of trained mason, rusting and leakage in iron sheet dome, low production of gas during winter, difficulty getting subsidy, low production of gas, lack of money, unavailability of spare parts and defunctness of plant while less important constraints were choaking of inlet and outlet, cracking of plant, fear of catching fire and unhygienic condition due to plant.

Gandhi and Patel (1988) found that rural women in Gujarat were very happy with biogas project. They felt that now there were no colds and burning noses for their children who were constantly with them in the kitchen. Besides, they saved time in collecting firewood every day, their vessels were clean and there were no flies all around.

Bhatisk (1990) stated that biogas owning women spent less time in arrangement of fuel, cooking of food etc.

Bhatnagar *et al.* (1990) said that biogas can be used for cooking and lighting benefits with convenience that also generates economic benefit in terms of saving fire wood as well as chemical fertilizers besides social benefits like eliminating drudgery of women and children in collection of fuel, elimination of eye and lung diseases caused due to smoke saving in cooking time and improvement in sanitation and environment.

Gill (1990) expressed his positive reaction that biogas is very neat clean and cheap source of energy, cow dung if burnt, in chulha has very low thermal efficiency but it is used in biogas plants, it produces very efficient gas and gives very good fertilizer for fields. So, the use of biogas should be preferred when large quantities of cow dung is available at home.

Manjappa (1990) reported that the families use biogas mainly for cooking, but in emergency conditions, they use it for lighting. The farmers stand to gain an additional monetary benefit of Rs. 1000 by way of manure production.

Chole (1990) reported that about 88.0 per cent respondents perceived very high utility of biogas while 11.67 per cent opined that its utility was high. None of the respondents perceived its low or no utility. He further observed that major use of biogas was done for cooking of food. About 98 per cent respondents used biogas for cooking of food, 10 per cent for lighting in house and 15.00 per cent for water heating.

Tawde and Ranmare (1990) reported that majority of non-adopters (76 %) expressed their desire for installing biogas plants but their desire can't be fulfilled of installation due to delay in sanctioning the load, subsidy and non cooperative attitude of the band officials. They further reported that the inhibiting factors in acceptance of Janata (biogas technology were high capital

cost, initial investment, absence of generating direct income getting enough fire wood poor quality manure, bad small to the food cannot bear the risk and conditions of sick plants in the village.

Bhatia (1990) after conducting a case study found that although biogas engine technology was economic from the view point of society, it was not adopted by the farmers on a large scale due to the unfavourable macro environment created by the Government and because of an inappropriate pricing policy by the manufacturer.

Mehetre (1990) reported lack of management in implementation of biogas plants and attracted attention to a closer look at the institutional arrangement made for planning and establishing biogas plant and their evaluation and maintenance. In the VIII Five Year Plan document, Govt. of India admitted Lacunae in the implementation of IREP programme.

Yusuf (1990) reported that biogas technology has not yet achieved widespread applicability in Bangladesh because of cost, scarcity of cow dung and storage, research and development is now targeting these problems.

Kaul (1990) reported that as compared with a target of installation of 64,000 family size biogas plant, during 1989, about 74,000 units were installed showing an increase of 15.6 per cent over the target. A total number of 2524 water pumping wind mills have been installed. Nine wind farms of aggregate capacity of 10 MW have been set up while projects with a capacity of 2410 MW are under implementation in different states. Urjagram project were completed in 108 villages while 232 projects are under implementation in 18 states and union territories.

Kaul (1990) reported that the various non-conventional energy programmes are the MNES (Ministry of Non-conventional Energy Sources) runs for experiments with are NPBD (National Programme on Biogas Development).

NPIC (National Programme on Improved Chulha), Solar Thermal Extension Programme, Wind Energy Programme, Urjagram Programme, Micro/Mini Hydel Development Programme, Magneto Hydrodynamic Programme, Ocean Wave and Ocean Thermal Energy Programme, Hydrogen and Chemical Energies programme.

Nagpal (1990) found low acceptance for biogas, pressure cooker and smokeless chulha.

Bhatnagar *et al.* (1990) revealed that burning dung and wood for cooking being a traditionally and socially accepted practices prevalent in rural areas since ages, the rural family will prefer burning of the dung and wood for cooking instead of biogas option.

Gopalan (1990), it is estimated that nearly 90 per cent of energy consumed in the household sector is for cooking the balance for space heating. Cooking and lighting, in country with tropical climates the proportion for cooking is even higher as there is no need for space heating. On the supply side, the energy supplies form non-traditional fuels such as kerosene, electricity and gas is hardly 20 per cent the rest is from fuel wood, agriculture and mineral residues.

Gopalan (1990), the per capita consumption for commercial fuels generally increase with the income in urban areas. In the case of rural areas the per capita consumption of commercial fuel is rather nominal and consumption of non commercial fuel varies within a narrow range for different age group.

Nagpal and Yadav (1991) symbolic adoption in a study conducted in Bhabhuala village of Hisar district found that less than half of the respondent (46.7 %) showed medium symbolic adoption level followed by low (33.3 %) and high (20.0 %) symbolic adoption level of bigas.

Bhat *et al.* (1991) reported that only 18 per cent of families were using smokeless chulha regularly, 6 per cent of families were using it in a modified form and 4 per cent were using it rarely. It was also observed that 55.5 per cent families had discontinued its use and 8.55 of the families did not use it. She further reported that regular users of smokeless chulha were not completely dependent on smokeless chulha.

Sootha (1991) mentioned that wind energy can be used for plumping water from underground for irrigation as well as for drinking purposes.

Chatterjee *et al.* (1991) applicability in a study conducted in Kankalitala Gram Panchayat of Balpur Sriniketan block found that the majority of user households consumed biogas for cooking purposes (63.24 %) and only 35.29 per cent for both cooking and lighting purpose. Scheduled tribes in households found consuming gas for lighting purposes in much large proportion compared to the other communities. Because unlike SCs or caste Hindus they don't cook normally twice a day.

Sootha (1991) reported that in India, wind generating systems of total capacity of about 85 MW are in operation in Maharashtra, Gujarat, Tamil Nadu, Madhya Pradesh and Orissa. The total potential of wind power generation in the country is over 20,000 MW.

Parameswaran (1991) reported that under NPIC, the anert (Agency for Non Conventional Energy and Rural Technology) has installed 33,933 chulhas dusting 1990. Out of these 19,958 were fixed chulhas and 13,835 were portable. 140 community chulhas has also been installed during the years. Since the inception of ANERT in 1986, up to 1991, ANERT has installed 1,28,204 fixed chulhas 50,003 portable one and 461 community chulhas.

Chatterjee *et al.* (1991) found that the cost of construction of small size gas plants is relatively high. It is for this reasons that only well to do rural

families can afford the cost of a gas plant. Government, assistance in the form of subsidy, bank loans etc. are available now. But it linked with the size of gas plant as well as socio-economic status of the beneficiaries.

Kumar *et al.* (1991) found that out of 79 villages of Puss block, biogas technology was adopted only 80 had installed biogas plant and made use of biogas technology.

Bhat *et al.* (1991) studied acceptability and utilization of smokeless chulhas in Delhi village and found that about 55 per cent women had discontinued the chulha after use and only 18 per cent were using it regularly.

Ghosh (1991) concluded that the better known sources are biogas and solar heat, while less known ones include micro-hydroelectric power and wind energy. It is recommended that the rural population be educated in the use of alternative energy sources so that, conventional sources may be conserved for other essential uses.

Nagpal and Yadav (1991) revealed that 46.7 per cent of the respondents had high knowledge of biogas. The respondents adopters with medium and low knowledge scores were 40.0 per cent and 13.3 per cent respectively.

Nagpal and Yadav (1991) found that SES of respondent was significantly and positively associated with knowledge about biogas.

Negative association of SES has also been reported with knowledge (**Bali, 1992**) and attitude (**Pathak, 1981**).

Nagpal and Yadav (1991) concluded that mass media contact were significantly and positively associated with knowledge about biogas and with attitude towards biogas.

Nagpal and Yadav (1991) found that the variable change proneness was significantly and positively associated with knowledge about biogas. They

further found that the variable 'economic motivation' was significantly and positively associated with attitude towards biogas.

Rani and Malaviya (1991) developed a standardized scale on organizational communication effectiveness by using equal appearing interval scale technique suggested by Edward (1957).

Oberoi *et al.* (1992) cooking is one of the major routine activities which are performed by every home maker. She spends about 6-7 hrs daily in the kitchen during this time she was use a large quantity of fuel for cooking.

In India, approximately 90 per cent of households are using fuel wood during cooking and agriculture wastes as fuel for cooking. The increase use of fuel wood has created scarcity of fuel, in order to check this problem some measure of fuel conservation must be undertaken immediately.

Leach and Goven (1992) the rate of fuel collection can be converted into a monetary value using the existing price of wood fuel in order to give cash measure of the opportunity cost of wood fuel collection. In a Mexican example cited by the authors, the rate of wood collection was 62 kg/hour, while the local marker price of wood was Mn \$ 3.00 per kg. This gives a value to wood fuel collection of Mn \$ 18.60 per hour. The minimum labour wage was at that time Mn \$ 27.50 per hour.

Planning Commission (1992) the kind of bio fuel, its amount and availability on a daily basis and other factors that are specified to certain agro-climatic zones plays a key role in establishing the energy consumption pattern, while a significant proportion of energy may be used for heating waters and cooking areas such as the western Himalaya zones, in the east cost plain and hills energy, energy may only be consumed during cooking.

Rana and Grover (1992) developed and standardized an attitudinal scale to measure the training effectiveness on farm women towards the selected messages by using summated rating method.

Digraskar *et al.* (1992) expressed his positive attitude that with simple and perennially available raw material involving simple technology and less cost. Biogas technology reconciles two apparently conflicting aims of getting from cattle dung and agricultural residues cheaper and better fuel which could be used for cooking, lighting etc.

Soundarapandian (1992) in a study in Kamarajar district of Tamil Nadu positively reacted that the total time spent for food preparation was 8.76 hours per day before installation of biogas plants and the time has been reduced to 7.22 hours per day after using the plants. The time of 1.57 hours as an average was saved by the biogas plants per day and a total of 23.88 day was saved on average by a biogas owing family in a year. The reason is the resultant easy activities of cleaning of utensil and kitchen and cooking of food.

Digraskar *et al.* (1992) in a study on perceived level of utility of biogas plant by biogas plant holders found that more than half (66.67 %) of the respondents perceived high level of utility, one fifth (20.0 %) of the respondents perceived medium level of utility, while only 13.33 per cent respondents perceived low level of utility of biogas plant.

Maulik (1992) reported that with strong government support, Indian farmers are adopting biogas technology. Between 1974 and 1987 the total number of family sized individual biogas plant's jumped from 10,000 to more than 830,000, and 80 per cent increase.

Anonymous (1992) reported that the in Gujarat, in the Kalyanpura Urjagram project, a solar photovoltaic power back provides the villagers their own television, street lighting and each households with two lights. Each

household is also entitled to an improved chulha. Seven families in the village had solar cookers and a number of families used biogas for cooking. Biogas provided sufficient energy for cooking requirement of a family of 6 to 9 people.

Sinha (1992) identified various non-conventional energy sources in India as wind energy utilization, the small hydel, biogas programme and gasifier technology.

Digraskar *et al.* (1992) observed that high expenditure in maintenance of plant and initial cost of plant is high was the major economic problems reported by 26.6 per cent and 20.83 per cent of respondents.

Soundarapandian (1992) reported that the problems faced by the biogas owning families in installation and operating the biogas plant in Kamarajan district of Tamil Nadu were "non availability of technical knowledge in the initial stage, higher initial cost, non-availability of space, difficulty in collecting the dung during the period of cattle grazing difficulty in generation of gas in winter, non availability of proper maintenance and repairs facilities, delay in disbursement of subsidy by the government to the beneficiaries.

Pal and Mishra (1992) functional status of biogas plant in Haryana and found that only 20 per cent of biogas plants were functioning well. About 43 per cent plant functioned for more than 3 years but were not functional now. The main reasons reported were leakage in dome and main tenance and service related factors.

Quesrghi (1993) even in households that collect their own fuel, a reduction in wood availability is not likely to trigger fuel substitution in favour of commercial fuels, rather, as has been observed, the same free labour would be used to collect other "free" fuel source like shrubs, dung cakes and crop residues. The explains why fuel wood transition is not linked to income level and is not happening in rural areas.

Sumitra and Yadav (1993) developed a standardized scale for measuring the attitude of schedule caste women towards the selected messages by adopting summated rating method.

Malaviya *et al.* (1993) developed a standardized scale on effectiveness of synchronized slide by using method of equal appearing interval scale suggested by Thurstone and Chave (1929)

Kute (1993) reported various constraints associated with rapid acceptance of biogas such as high cost of installation, lack of maintenance and servicing facilities, availability of water, water accumulation gas pipe line and food habits of woners.

Anonymous (1993 a) reported that various non-conventional solar energy devices are solar thermal collectors, liquid heating collectors, air heating collectors, concentrating collectors solar water heating systems, solar cookers, solar drying systems, solar desalination systems, space heating, cooling and passive construction, solar green house, solar thermal water pumping system, solar ponds, solar photovoltaic systems and solar lanterns.

Marawanxika (1993) reported his positive attitude towards biogas that biogas enables people living in rural areas to make use of their own resources with the mean at their disposal and to obtain a low cost inexhaustible supply of energy and fertilizers. For women, in particular, biogas technology spells progress-smoke free kitchens, more convenient cooking and no more walks to get the firewood.

Anonymous (1993 a) reported that solar thermal systems installed in India included 18659 solar water heating system, 10195 solar distillation, units 2880, 28 solar cookers, 61 solar crop drying units and 72 solar timber kiths. Solar photovoltaic system installed in the country included 29198 street lighting

systems, 14594 domestic lighting systems, 784 community TV/lighting systems, 756 water pumping systems and 409 KWP power plants.

Anonymous (1993 b) stated that a number of wind pumps are already operating efficiently in Tamil Nadu, Pondicherry, Gujarat, Maharashtra, U.P., Rajasthan, Bihar and Karnataka.

Anonymous (1993 b) reported that wide applications of wind energy are found as wind pumps, to pump water for domestic use and irrigation as an alternative to diesel/electric pumpsets and power generation from wind to generate electricity, etc.

Bhowmic and Chakraborty (1993) recommended that if the demand for the commercial energy sources is not to reach crisis point, there must be a development of alternative renewable energy sources such as solar and wind power, biomass, gobar gas and hydroelectric power.

Dendukuri and Mittal (1993) suggested a number of measures for enhancing the efficiency of energy use in rural household systems such as installation of improved chulha, family size biogas plant, energy plantation, utilization of SPV system for power generation installation of wind mills for lifting water and briquetting. Because an energy system based on local resources can improve productivity and standards.

Seth and Singal (1993) observed that though 93 per cent women were aware of biogas, 70 per cent of smokeless chulha and 45 per cent of solar cooker, yet their adoption extent was only 11.5, 27.0 and 0.0 per cent for the three technologies, respectively.

Kaushik and Verma (1994) reported that majority (70.0 %) of adopters had high level of knowledge for biogas while 51.11 per cent non-adopters had low knowledge profile.

Kaushik and Verma (1994) concluded that maximum adoption extent was found for pressure cooker followed by Nutan stove, biogas, portable chulha, solar cooker and smokeless chulha.

Kaushik and Verma (1994) concluded that the variable 'change proneness' accounted for significant variation in the knowledge level of rural women regarding energy technologies.

Kaushik and Verma (1994) developed and standardized an attitude scale for selected energy technologies by applying summated rating method.

Chaturvedi (1994) revealed that majority of respondents had either low or just average knowledge regarding fuel management. This included knowledge of homemakers about effects of fuel on health and environment time and energy saving equipments and conservation practices.

Kaushik and Verma (1994) concluded that the attitude of majority of rural women was found favourable for biogas and unfavourable for solar cooker and smokeless chulha. There was no significant difference between attitude of adopter and non-adopter.

Kaushik and Verma (1994) reported that the main constraints faced by rural women related to biogas were high cost, technical difficulties in operation, practical feasibility in use and lack of post installation services.

Jha and Sinha (1994) concluded that age did not show any significant relationship with the acceptance of biogas technology.

Kaushik and Verma (1994) revealed that women of younger age could reach the levels of adoption of energy technology.

Kaushik and Verma (1994) concluded that age accounted for significant variations in the knowledge level of rural women regarding energy technologies.

Jha and Sinha (1994) concluded that family education was highly and significantly associated with the acceptance and use of biogas technology. They expressed that high family education seemed to play greater role in the acceptance of biogas technology.

Kaushik and Verma (1994) found that communication behaviour accounted for significant variation in the knowledge level and adoption extent of rural women regarding energy technologies.

Kaushik and Verma (1994) found that the variable change proneness was identified as having significant prediction value for adoption extent of rural women regarding selected energy technologies.

Chahal and Malaviya (1995) reported that psychological variable (innovation proneness, economic motivation and change proneness) was found to be associated with perceived acceptability index of biogas.

Chahal and Malaviya (1995) found that age was not associated with perceived acceptability index of biogas. Both the variables were independent.

The study conducted by **Nimbal and Ansari (1995)** revealed that considerable number of the biogas users expressed major constraints like accumulation of water in gas pipe line, high initial cost of construction of plant, lack of suitable space, covering of plant in winter and rainy season, delay in release of subsidy and quality of farm yard manure is degraded.

Kumar (1995) reported the reasons for non-adoption of biogas as lack of funds (27 %), poor performance of plant installed earlier (22 %), lack of proper space (19.27 %), traditional fuel easily available (14.40 %), problems of loan and subsidy (10.55 %), not liking food cooked on biogas (5.07 %) and scarcity of trained hands (2.43 %) as reported by the non-adopters.

Chahal and Malaviya (1995) found that family education status was not associated with perceived acceptability index of biogas. Both the variables were independent.

Chahal and Malaviya (1995) observed that overall SES was not associated with perceived acceptability index of biogas. Both variables were independent.

Chahal and Malaviya (1995) revealed that overall communication variables were not associated with perceived acceptability index of biogas. Both variables were independent.

Srivastava (1995) described the application of various non-conventional energy sources, biomass is potential source of energy for use as solid, liquid and gaseous fuel, biogas and improved chulha. Solar energy is used in solar cookers solar water heating system, solar dryers, solar air heater, solar desalination system, wood seasoning kilns solar steam generating system, solar cold storage, solar power generating systems, solar water pumping system and solar photovoltaic cells, wind energy is utilized for wind power generation, water pumping and wind battery charging.

Chahal and Malaviya (1995) reported that majority of the respondents had low attitude (40.0 %) towards biogas.

Lakshmi and Karthikeyan (1995) reported that 58 per cent of the respondents (biogas plant beneficiaries) expressed positive reaction that biogas can improve health while 28 per cent of them felt that biogas can improve human health to some extent. No body was against biogas plants.

Sharma *et al.* (1995) found that in rural areas of Agra, a majority of the biogas plant owners have favourably reported about the absence of smoke (92.5 %) after using the biogas for cooking and no blackening of utensils (75 %).

About 60 per cent of gas users have been observed saving in cooking time as well as biogas being very convenient in usage (55 %) other benefits each as social status, saving in time for fuel collection and improvement in sanitation etc. have been reported by 27.5, 25 and 20 per cent users, respectively. A good number (31) of those who had used the slurry manure in their farms reported that the yield of their crops had increased after its use.

Nimbal and Ansari (1995) found that nearly 64 per cent of the respondents biogas plant owners possessed medium level of knowledge and 17 per cent of them possessed high level of knowledge. The gain in knowledge may be due to fact that the owners have observed working plants and are convinced about its suitability and profitability, extension workers and biogas supervisors must have influenced that owners during their contacts.

Chahal and Malaviya (1995) found that majority of respondents had low symbolic adoption (44.28 %) and low perceived acceptability index (41.0 %) for biogas.

Kaushik and Verma (1995) reported that as far as the use extent was concerned, majority of biogas owners were using it rarely (45 %). Followed by those who had discontinued the technology (30 %). Only 15 per cent were using it regularly. Regarding solar cooker majority were using it rarely while 10 per cent were using it sometimes. As regards smokeless chulha surprisingly 46 per cent had broken down the chulha. Only 8 per cent of the respondents had used regularly.

Chahal and Malaviya (1995) concluded that most of the respondents perceived constraints relating to the regular care of the plant, removal of water from gas pipeline, high cost of biogas plant improper utilization of biogas for lighting and operating small engines and untasty food cooked on biogas.

Sharma *et al.* (1995) revealed that the reasons causing lower (37.4 %) operational rate of biogas plants may be classified into three i.e. structural defects in plants, operational problems and social/household problems as about 36 per cent of 67 non operational plants being non functional due to the structured defect of plants followed by operational problems (38.81 %) as well as the social and other constraints constituting a magnitude of about 25 per cent.

Nair (1995) mentioned different application of solar energy such as a cold storage unit solar collectors for heating and cooling, crop dryers generation of electricity by using sea water evaporated by the sun.

Mishra (1995) reported that under NPBD more than 16.62 lakh family sized and 865 large institutional/community biogas plant have been set up so far.

Parvati *et al.* (1995) reported that under the solar thermal extension programmes, 2490 solar water heaters, 4174 domestic solar heaters, 66 solar air heaters/dryers. 7683 solar stills have been installed in the country. A total of 1,19,471 Sq.m. collector areas installed on these system is capable of generating 80.64 million KWh thermal energy equivalent per annum. It is estimated that the wind power potential in the country is around 20,000 MW. At present about 43 KW aggregate wind power capacity has been established in the country including 6.5 MW in the private sector.

Kumar (1995) mentioned that a total of over 17 million improved chulhas have already been installed in the country covering 14 per cent of the estimated potential. So far about 3.4 lakh solar cookers, have been sold, over 68000 SPV domestic, street and community lighting systems and 112 village level small SPV power plants have been set up in the country. A major programme for promotion of 1,00,000 solar lanterns have been undertaken during 1994-95.

Srivastava (1995) reported that different non-conventional energy resources available in India are biomass, biogas, improved chulhas, solar energy, wind energy, microhydel power, ocean energy and geothermal energy.

Kumar (1995) reported that the rural energy programme implemented by MNES included biogas development, improved chulhas, solar photovoltaics (SPVs), Solar thermal technologies, SPV pumps, wind pumping programme, biomass gasifiers programme, Draught animal power, biomass production and utilization and Integrated Rural Energy Programme (IREP).

Parvati *et al.* (1995) suggested that one of the ways of meeting the energy crisis is to reduce dependence on finite sources of energy, namely fossil fuels and promote utilization of alternative and renewable energy source such as biogas improved chulha, solar energy, energy from wind and biomass.

Krishnan and Mishra (1996) reported that bioenergy, solar energy, draught animal power wind energy, small scale hydro power, ocean power, ocean power, tidal wave and OTEC (Ocean Thermal Energy Conversion) are among the various alternative source of energy.

Nathan (1997) indoor air pollution due to burning of biomass fuels has been shown to be an important factor increasing the prevalence of acute respiratory infections in infants and children and chronic obstructive lung disease (COPD) often leading to heart damage (cardiopulmonary).

Gandhi (1997) observed the limitation of the focusing of solar cooker. She noted the scope for its possible alteration/adoption/modification suited to Indian kitchen.

Yadav (1997) used multistage random sampling technique to draw a sample of 250 rural women respondents by covering three districts of Haryana state from dairying agro-climate conditions. Nine attributes of solar cooker as

perceived by rural women respondents were studied by paired comparison technique constraints as perceived by rural women in adoption of solar cooker were identified by application of Z test. The results revealed that relative advantage (SV=1.064) and labour saving (SV = 0.855) were the best perceived attributes while terminality (SV=0.203) and cost (0.000) were the least preferred attributes of solar cooker. Inadequate knowledge regarding use and maintenance, poor technical know-how and skill to operate, frequent dull painting of containers, incompatibility with taste of food, high initial cost improver pre and post procurement services at village level and resistance to change by elders for solar cooker were the most serious educational, communicational, technological, economical, socio-cultural and situational constraints observed by the respondents.

Dr. Priya Karve (2000), a lot of research and development work is going on all over world on the use of biomass energy in the rural domestic energy sector in developing country.

Biomass : Versatile Source of Energy October (2000) reported that electricity is the key to economic development for any country. During the last five decades the demand for electricity has increased manifold in India, primarily due to the rapid rate of urbanization and industrialization. The conventional fossil fuel resources for power generation are fast depleting and there is a growing concern over the environmental degradation caused by conventional power plants. Against such implications, power generation from non-conventional resources assumes greater significance. Among the various renewable energy sources, biomass conversion technologies appear to be one of the best suited for conversion to shaft power/electricity.

The term 'biomass' refers to organic matter, which can be converted to energy. Some of the most common biomass fuels are wood, agricultural

residues, and crops growth specifically for energy. In addition, it is possible to convert municipal waste, manure or agricultural products into valuable fuels for transportation, industry and even residential use.

Reddy Amulya (2000) says, solar cookers and improved wood stoves have made only a marginal differences thus far in India. In the first place these devices are costly and unaffordable to a large segment of the rural community in India. Rural communities are accustomed to meeting their energy needs without monetary expenditure. Secondly, the technologies are still in the process of evolution.

More importantly, these non-conventional energy devices are not always suited to local needs, for instance, Jowar roti (an Indian leafy bread made out of maize flour) accounts for a lion's share of cooked food in some parts of rural India, but it cannot be cooked using a solar cooker.

Karve (2000) says, nearly 75-80 per cent of the population in the developing world relies on wood and waste biomass as fuel for cooking and room heating. In most cases, the agricultural and forestry waste biomass is used as fuel, but in certain regions of the world, the demands of the domestic energy sector have put a severe pressure on the precious forest resources. This in itself is a cause for environmental concern. However, a more critical issue is that of the pollution of the indoor air due to the soot and smoke produced by inefficient combustion of biomass fuels inside the house.

Several studies conducted over the last couple of decades have revealed that poor indoor air quality is one of the major factors contributing to the poor state of health of rural women and children in the developing countries. 1.5 per cent of the total deaths among Indian women can be attributed to chronic diseased of the respiratory system. Among these the percentage of women using wood or biomass for cooking for 10-15 years is very large. The percentage of

blindness and tuberculosis is the highest among women using traditional chulhas, as compared to any other population group. Through several recent studies a direct correlation is emerging between death and diseases in infants and young children, and use of wood and biomass as fuel in the house. An important factor to be noted in this context is this : The number of untimely deaths is just one side of the coin. A general and chronic state of poor health or a disability like blindness adversely affects the way of life and that too must be borne in mind while assessing the health impact of poor indoor air quality.

International Market Research – Non-conventional Energy Scenario
 ... **Savio Gonslaves (2001-2002)** says, India has the world's largest programme in renewable energy (RE) products and system. The Indian Ministry of Non-Conventional Energy Sources (MNES) formulates and implements the RE programme across the country and the Federal Indian Renewable Energy Development Agency (IREDA) provides finance for commercial programmes. The programme covers all major RE source like solar thermal, Solar Photovoltaic (PV), biogas biomass, wind, small hydro power, urban waste and other emerging technologies. The investment in RE is estimated to be about US \$ 3 billion. Of the estimated potential of 100,000 MW from RE only about 3500 MW has been exploited to-date. The Federal Government has set a medium scale goal of electrification of 18,000 remote villages and meeting 10 per cent of the country's power supply through renewable energy by the year 2012. These targets are in addition to those fixed for other renewable energy devices or programmes. The manufacturing base for certain RE devices like solar cookers, solar water heater, medium capacity gasifiers, biogas plants, etc. is fairly good in India. Tremendous potential for high quality, sophisticated and high value products exist. Processed raw material for solar cells, large capacity SPV

modules, their film solar cells, SPV roof tiles, inverters, charge controllers, etc. have good market potential in India.

Ministry of Non-conventional Energy Sources Demand No. 59 (2001)

reported that biogas programme aims at providing clean gas for cooking, lighting and electricity generation and enriched manure from cattle dung and night soil. Besides the programme helps in conservation of fuel wood, improve kitchen environment and sanitation and employment generation in rural areas. The programme includes popularization of both family type and bigger sized community/Institutional/Night soil Biogas plant and also research and development on biogas. The National Project on Biogas Development (NPBD) inter-alia provided subsidy to farmers for setting up biogas plants and fees for Turnkey job worker and rural energy technicians for quality construction and repair and maintenance services for biogas plants for a period of first three years. For community institutional and night soil biogas plants also, Government provides financial assistance.

R.K. Pachauri and Pooja Mehrotra *et al.* (2001) Food security for a growing population cannot be attained without the elimination of rural poverty. Solving the energy problem of the rural areas can be a major component of poverty alleviation and requires understanding the nature of energy use, the available technology choices and fuel mix for these areas. Rural areas of most developing countries rely predominantly on biofuels mainly fuel wood, for their fuel needs. Biomass fuels-fuel wood, crop residues and animal dung provide 85-90 per cent of domestic energy in rural areas and 75 per cent of all rural energy. In the rural economy of India, for example, the domestic household sector is the most prominent energy consumer, followed by the agricultural sector.

Inefficient biomass use in traditional devices has serious environmental effects, locally and globally. The burning of biomass fuels leads to high levels of

indoor air pollution that especially affect women and children. Deforestation and a rapidly declining resources base make provision of alternative energy to rural areas for ecological sustainability a crucial pre-requisite for food security.

Renewable Energy Technologies (2002) reported, India has a large potential renewable energy (RE) an estimated aggregate of over 100,000 MW. In addition, the scope for generating power and thermal applications using solar energy is huge. However, only a fraction of the aggregate potential in renewables and particularly solar energy, has been utilized so far.

TERI Energy Data Directory & Yearbook (2003/2004) reported, the MNES was created in 1992 as a separate entity under the Gol replacing the erstwhile Department of Non-Conventional Energy Sources. The MNES is primarily responsible for policy formulation, resource assessment, R&D, demonstration commercialization, and large-scale utilization of NRSE such as biogas, biomass, solar energy, wind energy, small hydropower, improved chulhas, ocean energy, geothermal energy, alternative fuels, hydrogen and draught animal power. Other important activities of the MNES include awareness creation and information dissemination for the popularization of non-conventional renewable energy devices and systems and fostering of cooperation for financial and technical assistance from multilateral and bilated agencies. On the basis of end-use of RETs (renewable energy technologies) the MNES has three broad sectoral groups. (1) Rural energy (2) Urban and industrial energy and (3) Power generation. This structure has been designed keeping in mind the objective of promoting commercialization, market orientation, and private sector participation.

(Annual Report 2001-2002 New Delhi : Ministry of Non-Conventional Energy) From times immemorial, non-conventional energy sources have been used for various applications such as for drying farm produce using solar energy

and pumping out water using wind mills. The general interest in non-conventional energy, sources in India received an impetus following the oil shock of the 1970s backed by political commitment on the government's part. Today, India boasts perhaps the only Ministry of Non-conventional Energy sources in the world. The Ministry manages one of the world's largest renewable energy programmes covering the whole spectrum of renewable energy technologies for a variety of grid and off grid applications. The country has the largest decentralized solar energy programme, the second largest biogas and improved cook stoves programme and the fifth largest wind power programme in the world.

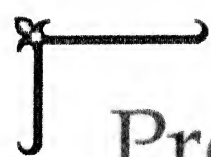
Morley (2001) says, as women no longer have to spend hours away from their homes traveling (often long) distance to collect wood for cooking and heating, they can free up valuable time for activities, which they would otherwise be unable to do. At home, they can spend more time caring for their children. When family members suffer (although hopefully less frequently than before) from disease, families have a greater chance of being able to provide medical care if households are able to save money by not buying fertilizers and generate more income from selling surplus produce.

Dasika Vinayak Nag (2005) says major thrust is being given towards research development demonstration commercialization and deployment of new and renewable energy systems/devices for transportation, portable and stationary applications for rural urban industrial and commercial areas. Ultimate fuels for surface transportation including electric/hydrogen/hybrid vehicles. Bio-fuel is being developed for motive power for stationary/portable applications.

Sudhirendar Sharma (2005) says, from biogas to solar cookers and improved cook-stoves, from agricultural tools to drudgery reducing technologies, most research and development in appropriate technologies has not

been backed-up by appropriate market incentives. The contrast, hi-tech is totally market driven. Be it endogenous or exogenous, technology has in many ways shaped lives and livelihoods in the rural areas. From the humble sickle to the mighty combine harvester technology has come to symbolize the level of progress of a society. Yet the access and acceptability of the technology per se has remained influenced by diverse socio-economic and cultural conditions.

From biogas to solar cooker dissemination from improved cook stove to solar lantern development, and from agricultural tools to drudgery reducing technologies, most research and development investment in the sector hasn't been backed up by appropriate market incentives to bring about desired impact. In contrast hi-tech is totally market driven.



Profile of the Study Area

Chapter-III

PROFILE OF THE STUDY AREA

It seems to be necessary to give brief description of tract in which the study has been conducted. This will increase the practical feasibility of the results with this view, a brief description of the locale of the study.

Location

Fatehpur is one of the four districts of Allahabad division of U.P. This district has between $25^{\circ}26'$ and $26^{\circ}16'$ north latitude and $80^{\circ}14'$ and $81^{\circ}20'$ east longitude. The district is bounded on the north-west by Kanpur and on the south-east by Allahabad. In shape it is roughly rectangular, having the total geographical area is 4152 km^2 . To the north beyond Ganga lies the south district of Unnao, Raebareilly and Pratapgarh while on the south the Yamuna separates Fatehpur from the Hamirpur and Banda districts. The district is divided into three tehsils and thirteen development blocks.

Climate

The district has semi arid climate characterized by hot summer during May-June and severe cold during December-January. Generally climate is quite similar to that part of entire doab from Agra to Allahabad with the little variation. The cold weather starts at the end of October and the temperature falls gradually till it reaches its minimum about 8°C in the month of January, from March to the beginning of rainy season. It is characterized by extreme heat and dryness, intensified by strong western wind (100) occasionally interrupted by violent dust storms. The temperature sometimes reaches as high as 48°C in the month of June.

The optimum annual rainfall of Fatehpur district is 938. The heavy rain occurs in the month of August-September.

Soil

The district however, consists of the doab soil known as bhoor or sandy. The soil exhibits various composition and appearance but on the whole, is quite similar to that found in the middle of river Ganga and Yamuna. But as whole soil of district differs from area to another.

Table 3.1 General information of the district Fatehpur

S.No.	Particular	Unit	Periods	Details
1.	Geographical area	Sq.Km.	1995-96	4152.00
2.	Population	000	-do-	1892.69
	Male	-do-	-do-	1009.00
	Female	-do-	-do-	889.89
	Rural	-do-	-do-	1711.23
	Urban	-do-	-do-	
	Scheduled caste	-do-	-do-	469.45
	Scheduled tribe	-do-	-do-	0.31
3.	Literacy	-do-	-do-	688.00
	Male	-do-	-do-	487.78
	Female	-do-	-do-	193.13
4.	Tehsil	Number	-do-	3
5.	Development blocks	-do-	-do-	13
6.	Nyay Panchayat	-do-	-do-	132
7.	Gram Sabha	-do-	-do-	789
8.	Villages	-do-	-do-	1532
9.	Nationalized Banks	-do-	-do-	51
10.	Gramin Banks	-do-	-do-	55
11.	Co-operative Banks	-do-	-do-	32
12.	Land Development Banks	-do-	-do-	3

13.	Post Office	Number	1994-95	253
14.	Biogas plants	-do-	-do-	3469
15.	Cold storages	-do-	-do-	6
16.	Total cropped area	000 ha	-do-	295
17.	Total irrigated area	-do-	-do-	17.2
18.	Agricultural production			
	Cereals	000 M.T	-do-	549
	Sugarcane	-do-	-do-	427
	Oilseeds	-do-	-do-	13
	Potato	-do-	-do-	99
19.	Irrigation			
	Canal	Per cent	-do-	21.10
	Govt. tube well	-do-	-do-	2.12
	Private tube well	-do-	-do-	75.86
	Others	-do-	-do-	1.22
20.	Education			
	Degree colleges	-do-	-do-	85
	Polytechnics	-do-	-do-	1
	Industrial training Institute			
	Primary schools	Number	-do-	1223
	Junior High Schools	-do-	-do-	281
	High School/Intermediate colleges	-do-	-do-	98
21.	Public health			
	Allopathic	-do-	-do-	17
	Homeopathic	-do-	-do-	12
	Unani	-do-	-do-	5
	Ayurvedi	-do-	-do-	21
	Primary Health Centre	-do-	-do-	55
22.	Electricity			
	Total village	-do-	-do-	985
	Total town	-do-	1991-92	905
	Cinema hall	Number	1994-95	12
	Hand pump/India Mark-2	-do-	-do-	1359

Table 3.2 Area and land utilization pattern in district Fatehpur

S.No.	Particulars	Area in ha	Percentage
1.	Geographical area	425200	100.0
2.	Net sown area	288012	67.73
3.	Land not available for cultivation	44860	10.55
4.	Building and others	34058	8.00
5.	Current fallow land	31059	7.30
6.	Agricultural barren land	11652	2.47
7.	Under afforestation	6113	1.43
8.	Forest	5188	1.21
9.	Pasture	2355	0.54
10.	Miscellaneous	2126	0.50

Population

The crop grown is district area as under.

Kharif

Paddy, maize, jowar, bajra, urd, moong, til, arhar, groundnut and vegetables.

Rabi

Wheat, potato, barley, gram, pea, mustard, lentil, sugarcane and vegetables.

Zaid

Moong, watermelon, sunflower, jowar and vegetables.

Source : Statistical report Fatehpur.

The development block under study is located in tehsil Fatehpur. It is situated at a distance of 13 km. Away from Fatehpur headquarter.

Table 3.3 Area utilization of Haswa block

S.No.	Particulars	Area (in ha)
1.	Total geographical area	32276
2.	Total cultivated area	21985
3.	Forest	70
4.	Current fallow	3605
5.	Pasture	400
6.	Cultivated barren land	480
7.	Uncultivated area	736
8.	Usar & others	1903

Source : Atlas of district Fatehpur

Table 3.4 General information of Haswa development block

S.No.	Particulars	Area (in ha)
1.	Total area	322.76 Sq.km.
2.	Population (1991)	
	Rural	3244.81 (000)
3.	Literacy (1991)	39.4 %
	Male	55.7 %
	Female	20.5 %
4.	Villages (1994-95)	98
5.	Primary health centre/sub-centre	25
6.	Post office	21
7.	Banks	10
8.	Primary schools	82
9.	Junior high schools	22
10.	High School/Intermediate colleges	3
11.	Degree colleges	-
12.	Irrigated land	14009 ha
13.	Distance from railway station	1 km.
14.	Distance from district headquarter	13 km.
15.	Nyay Panchayat	12
16.	Gram Sabha	56
17.	Electrified villages	74

The development block under study is located in tehsil Fatehpur. It is situated at a distance of 3 km away from Fatehpur headquarter.

Table 3.5 Area utilization of Teliyane block

S.No.	Particulars	Area (in ha)
1.	Total geographical area	23752
2.	Total cultivated area	10128
3.	Forest	152
4.	Current fallow	544
5.	Pasture	687
6.	Cultivated barren land	998
7.	Uncultivated area	1001
8.	Usar & others	2440

Source : Atlas of district Fatehpur

Table 3.6 General information of Teliyane development block

S.No.	Particulars	Area (in ha)
1.	Total area	23752 ha
2.	Population (1991)	
	Rural	105149
3.	Literacy (1991)	41.4 %
	Male	61.3 %
	Female	26.3 %
4.	Villages (1994-95)	101
5.	Primary health centre/sub-centre	34
6.	Post office	12
7.	Banks	12
8.	Primary schools	127
9.	Junior high schools	22
10.	High School/Intermediate colleges	3
11.	Degree colleges	-
12.	Irrigated land	19193 ha
13.	Distance from railway station	4 km
14.	Distance from district headquarter	3 km
15.	Nyay Panchayat	9
16.	Gram Sabha	55
17.	Electrified villages	67



Research
Methodology 

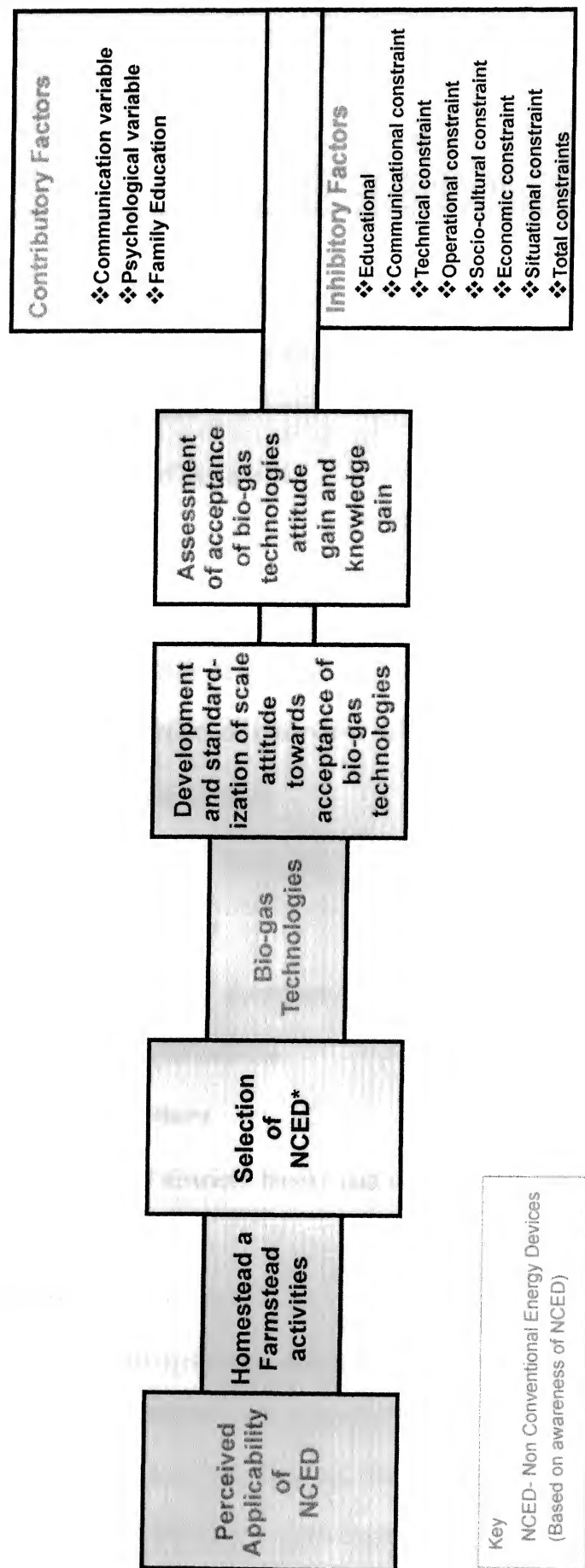


Fig. No. 4.1: Research module of the study

Chapter-IV

RESEARCH METHODOLOGY

The methodological steps adopted for studying the perception of rural women regarding the applicability of NCEDs recommended for use in farm and home are given below :

1. Locale of the study
2. Sampling procedure
3. Variables and their measurement
4. Assessment of perception of applicability of NCEDs
5. Construction of interview schedule
6. Collection of data
7. Analysis and interpretation of data

1. Locale of the study

The study was conducted in U.P. state, keeping in mind the easy accessibility and convenience.

2. Sampling procedure

The listing of districts, blocks and villages included those where work on NCEDs was done.

3. Selection of district

District Fatehpur was purposively selected for this study as the research hailed from this place. This helped the investigator to collect the necessary information accurately and timely. The researcher, being from the same place could easily have dialogues and discussion with the respondents both during pilot study and final data collection.

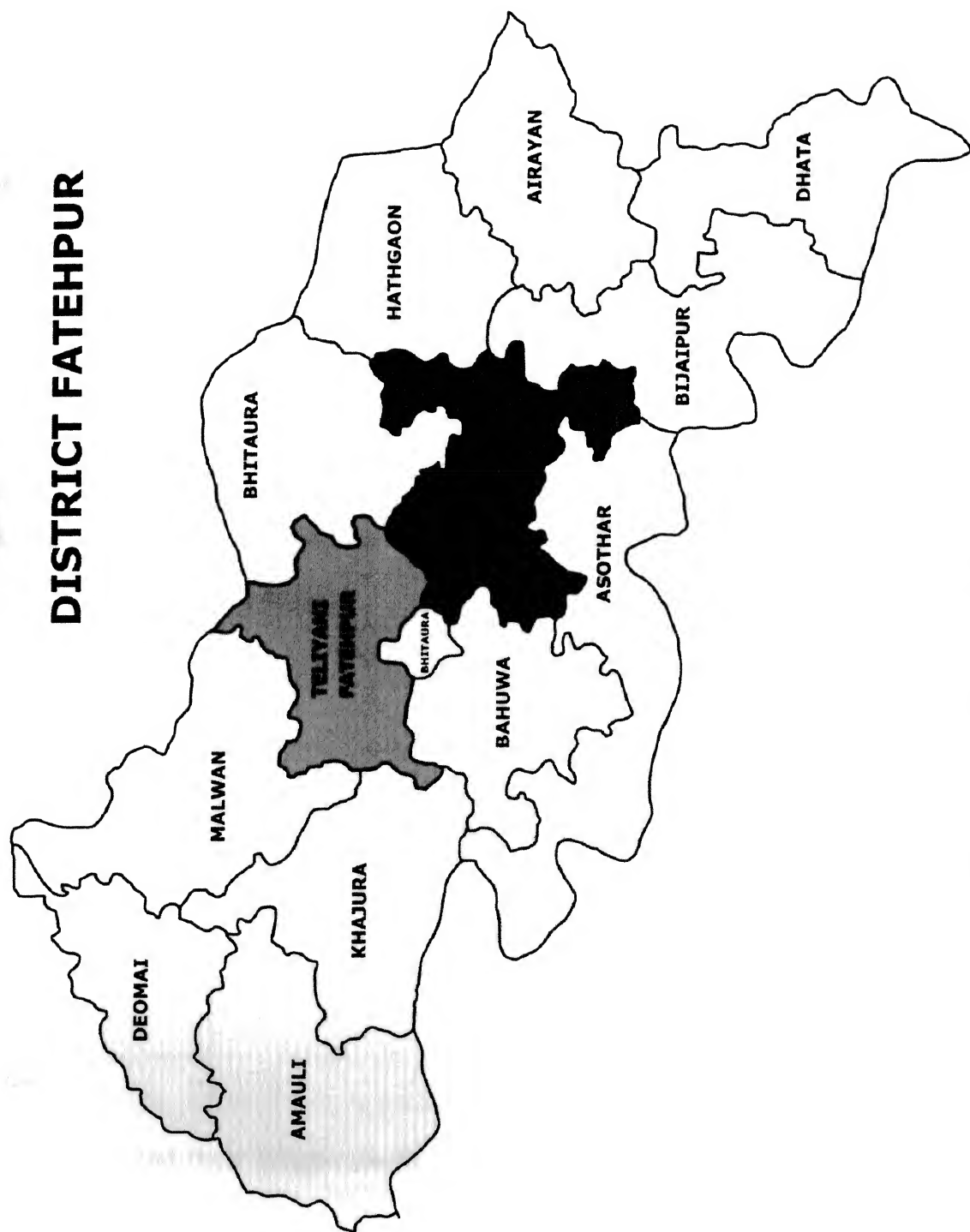


Fig. No. 4.2: Map of Fatehpur District

4. Selection of blocks

A list of blocks was prepared on above criteria and out of this list, two blocks namely Haswa and Teliyani were selected randomly.

5. Selection of villages

A list of villages prepared on above criteria and out of this list twelve villages i.e. six from each block were randomly selected.

6. Selection of respondents

Total households of the selected villages was prepared with the help of block office and district headquarter.

Table 4.1 A proportionate sample was drawn from each village was shown below

District	Block	Village	Proportionate sample
Fatehpur	(i) Haswa	(1) Aooraiyee	28
		(2) Kusumbhee	11
		(3) Karanpur	12
		(4) Maneekheda	12
		(5) Manava	14
		(6) Narainee	9
	(ii) Teliyani	(7) Sahalee	12
		(8) Ravatpur	23
		(9) Thithoora	30
		(10) Baijane	14
		(11) Dugreyee	21
		(12) Kooranyee	14
Total			200

3. Variables and their measurement

Independent variables

The socio-personal, economic, psychological and communicational variables constituted the independent variables for the study.

HASHWA

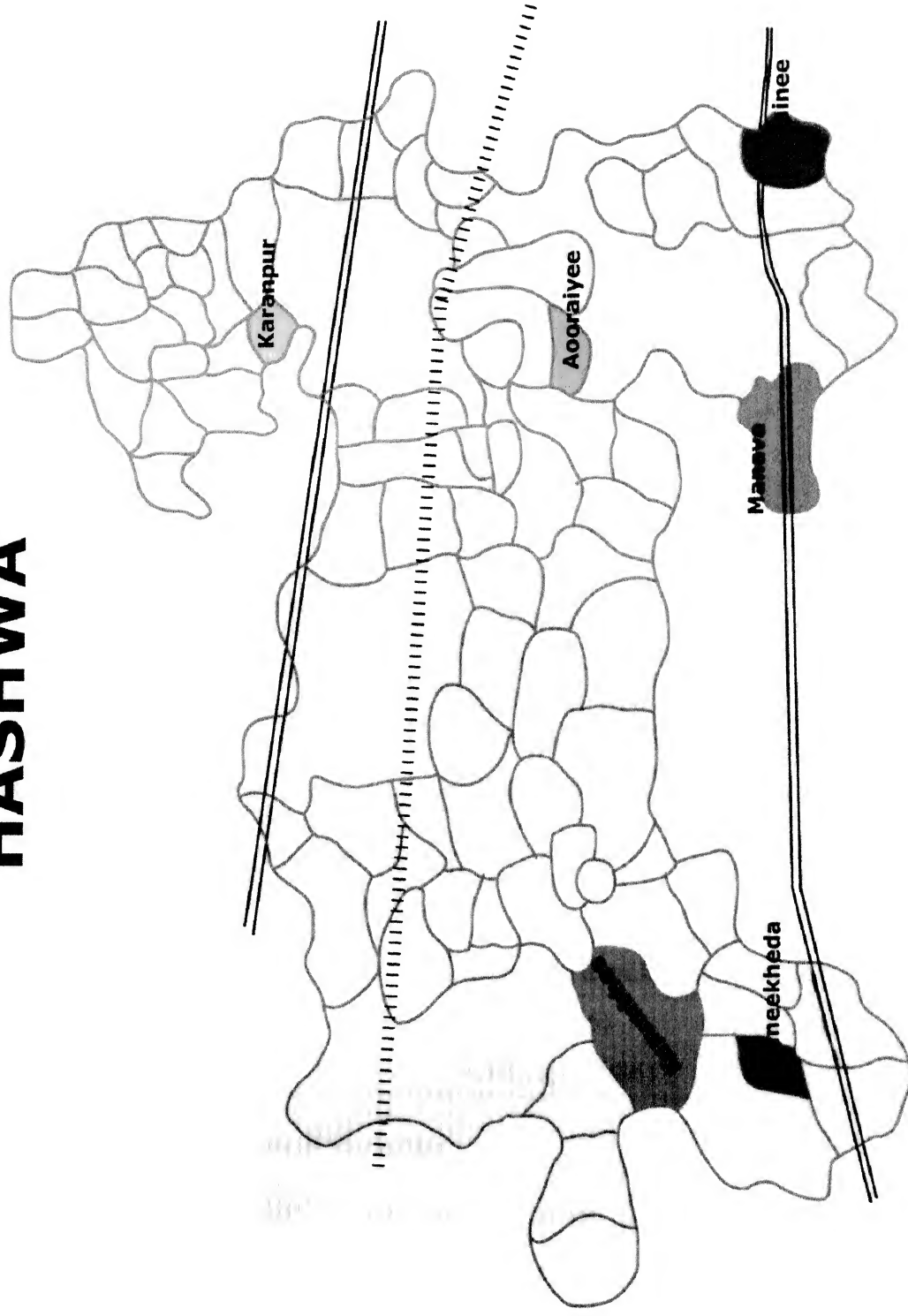


Fig. No. 4.3: Map of Hashwa Block

Variable studied	Instruments used
<u>Socio-economic and personal variables</u>	
Age	Chronological age Narwal (1982)
Family	Modified socio-economic status scale (Rural) Trivedi (1963)
Caste	
Occupation	Modified socio-economic status scale (Rural) Kulshrestha (1980).
Education	
Social participation	
Land holding	
Family type	
Family size	
Herd size	
House type	
Income	
Material possession	Modified index Kulshrestha (1980), Narwal (1981) and Pannu (1990).
<u>Psychological variables</u>	
Innovation proneness	Modified self rating scale Moulik (1965)
Risk orientation	Modified Risk preference scale Supe (1969)
Economic motivation	Modified self rating scale Moulik (1965)
<u>Communication variables</u>	
Information source	
Information source	Schedule developed
Mass media exposure	Kaur (1986)
Extension contact	Kashyap (1988)

Measurement of independent variables

Different independent variables were selected as per requirements of the study and measured by use of various appropriate tools. The scoring was done as per scale/schedule instructions.

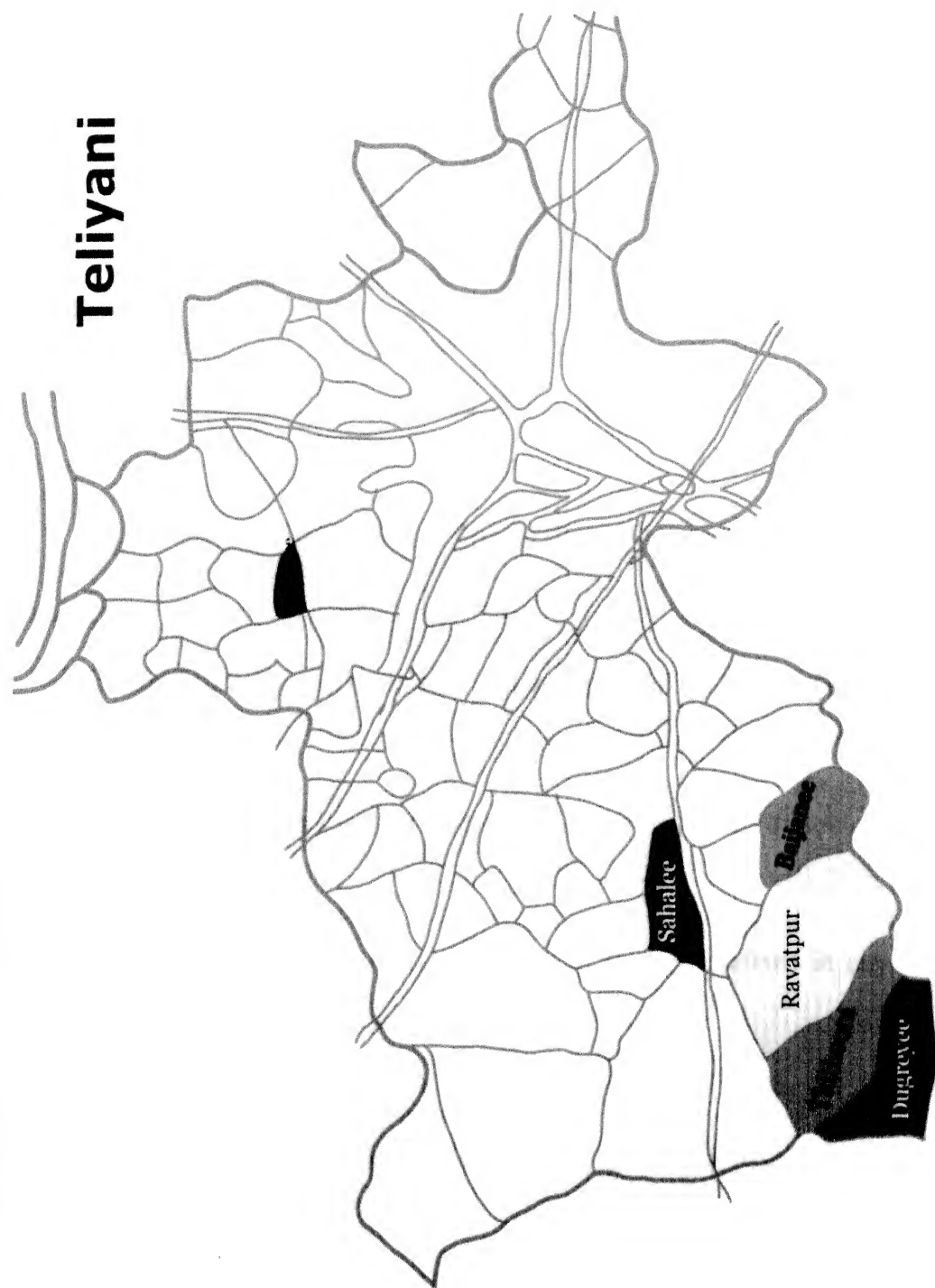


Fig. No. 4.4: Map of Teliyani Block

Socio-personal and economic variables

Age

It refers to the number of full years completed by the respondents at the time of investigation. Accordingly chronological age of the respondent at the time of investigation was measured by direct questioning.

Family education

Educational status of the family was operationally defined as the formal education attained by the family members who were above 6 years of age. This was measured and quantified according to index developed by Narwal (1982) and scores were assigned accordingly.

Occupation

Occupation refers to the head of family's means of livelihood.

Education

It refers to the years of formal education acquired by the respondents.

Caste

Caste refers to the class or distinct there dietary order of society

Social participation

It refers to the degree of involvement of the respondents in any formal or informal organization as a member or an office bearer.

Land holding

It refers to the land in acres possessed by the respondents family.

House type

It was operationalized as the type of material used for the construction of house.

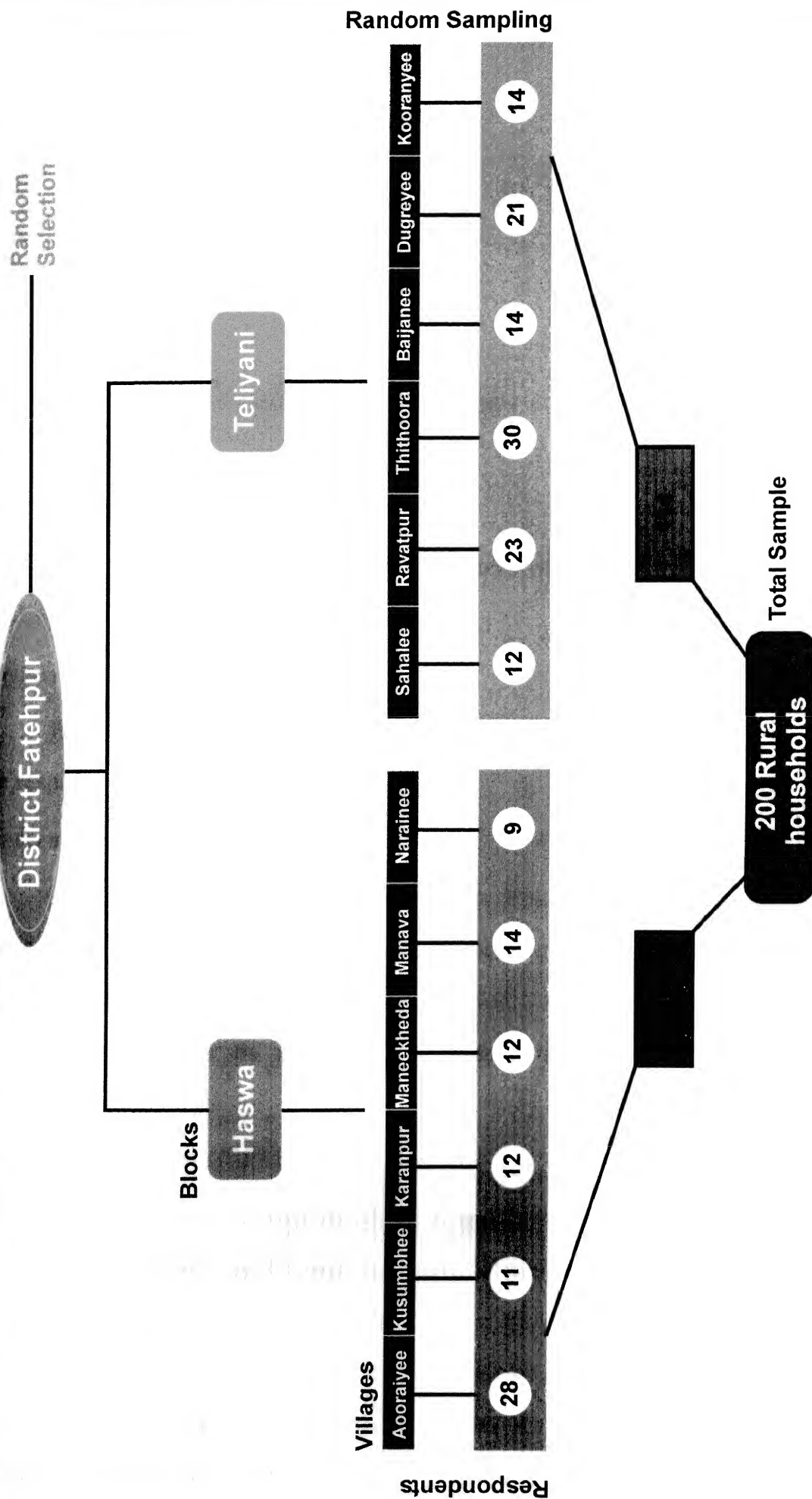


Fig. No. 4.5: Sampling procedure for the study

Family type

It means whether it is a nuclear or joint family. Nuclear family is composed of parents and children only. Joint family refers to one, which is composed of two or more brother's families.

Family size

It refers to the total number of members in that family whether it is nuclear or joint.

Herd size

Herd size was operationalized as the number of livestock possessed by the respondents.

Income

Income was operationalized as the average monthly income possessed by the respondent's family.

Material possession

It was operationalized in terms of household and farm equipments, goods and facilities for transportation and communication possessed by the family of the respondents. These items were categorized into three parts (i) Agril. Implements, (ii) domestic item, and (iii) transportation and communication means.

Socio-economic status (SES)

It is defined as the position of the respondents in the society which is ascertained by various social and economic variables, which include caste, occupation, education, family type, family size, type of house, land holding, social participation, herd size, livestock type, income, material possession. The scores received by each respondent for each of the variable were added to estimate socio-economic status. The SES scores were categorized into three

categories as given below on the basis of cumulative frequency and the respondents were categorized in three groups.

Categories

1. Low
2. Medium
3. High

Psychological variables

Innovation proneness

Innovation proneness refers to the substitution of something new for another for growth of the society for a better living. This was measured by using modified self rating scale of Moulik (1965).

Risk orientation

It is the degree to which a farm woman is oriented towards risk and uncertainty and has the courage to face the problems. This was measured by using modified risk preference scale developed by Supe (1965).

Economic motivation

These are the attributes which are related to maximization of profit in short or long term. This was measured by using modified 'self rating scale' developed by Moulik (1965).

Based on the above three variables scores psychological factor of the respondents aggregated and estimated and grouped into three categories for further analysis.

Categories

1. Low
2. Medium
3. High

Communication variables

Information source

This refers to the information sources used by respondents for obtaining knowledge and information about farm/household and livestock. This was quantified on the basis structured interview schedule including information on localite and cosmopolite sources.

Mass media exposure

It refers to the degree to which a rural woman has contacted the mass media for obtaining the information on the required subject. This was measured with the modified scale developed by Kaur (1986).

Extension contact

It is the degree of contact with extension functionaries. The variable has been operationalized as the intensity or extent of contact of the respondents in terms of frequency of contact with extension personnel and was measured with the index developed by Kashyap (1988).

Based on the above variables communication factor of the respondents was estimated and grouped into three categories as given below :

Categories

1. Low
2. Medium
3. High

Dependent variables

Perception of rural women about applicability of different NCEDs recommended for use in farm and home was taken as dependent variable.

Assessment of perception of applicability of NCEDs

Gibson (1959) defined perception as the process by which an individual maintains contact with the environment. Kollat *et al.* (1970) explained perception as the process whereby an individual receives stimuli through the various sense and interprets them. The dictionary meaning of the word perception is "the act of perceiving." The action of the mind in referring sensations to the object which caused them. It is the awareness through the senses of an external object (New Webster's Dictionary and The Shorter Oxford English Dictionary) perception is initiated by environmental events or objects stimulating sensory organs such as the eyes, ears, tongue, nose and skin. One of the most important problem in understanding the process is learning how the information about the environment is registered and responded to (The Encyclopedia of education).

Perception of the same situation may differ from individual to individual due to differences in their experiences and ways of looking into it. The expectations, needs and ways of thinking influence how an individual interprets what is observed.

Perception is selective and we perceive what we want to perceive. Our perceptions are organized and we tend to structure our sensory experiences in ways which make sense to us. Perception is influenced by the environment in which communication takes place. It is not the intrinsic quality or attribute of an object, individual or message but how people individually and collectively perceive them.

Farm and Home stead activities

A list of activities of homestead and farmstead, where different NCEDs can be used was prepared, after consulting relevant literature, various agencies

concerned with energy and concerned scientists that means the activities where NCEDs can replace the traditional devices used by rural families.

Operational use

In the present study, perception of rural women has been operationalized as the reactions of rural women with regards to the uses applications of different NCEDs. These uses have been studied under two broad categories, i.e. household operations and farming operations.

A close ended continuum on three point was used to study applicability of NCEDs namely "fully applicable", partially applicable and not at all applicable" for which weighted scores of 3, 2 and 1 were assigned.

Fully applicable means when the device was used/considered to be used by the respondent for that particular operation, each and every time without substituting it with any other supplementary device.

Partially applicable means when the device was used/considered to be used with other supplementary device even if any of NCEDs is available.

Not at all applicable means when the respondent was not using/was not considering to use that particular NCEDs.

(i) Selection of NCEDs

NCEDs were selected on the basis of the findings of the first objective related to the respondent's awareness of the devices.

Only those NCEDs were selected for final study where at least half of the total respondents (i.e. 200 respondents) were aware.

Four sub-technologies of biogas were selected as :

- * Biogas stove
- * Manure production
- * Biogas fuel engine
- * Biogas lighting

(i) Attitude towards acceptance

The respondents were asked to express their attitude on three point continuum namely "strongly agree, agree and do not agree" towards each of the statements for all the four biogas technologies as contained in the standardized scale which were assigned weightage of 3, 2 and 1 respectively for positive statements and reverse in case of negative statements.

There were 12, 10, 10 and 10 statements in the scale under biogas stove, manure production, biogas fuel engine and biogas lighting, respectively. Therefore, the obtainable scores by respondents ranged 12-36 in case of biogas stove and 10-30 in case of manure production, biogas fuel engine and biogas lighting.

The scores thus obtained by respondents were aggregated technology wise.

(ii) Knowledge

Knowledge refers to the amount of information an individual has as regards the various aspects of innovation. Bloom *et al.* (1956) defined knowledge as those behaviours and test situations, which emphasize the remembering either by recognition or recall of ideas, material or phenomenon.

Knowledge is one of the important components of behaviour and as such it plays a major role in the covert and overt behaviour of human beings once knowledge is acquired, it produces change in their mental ability to think positively.

It could be said further that a complete working knowledge is essential for proper acceptance/adoption of any innovation. Further, it is the part of an information which is in accordance with the established facts. The knowledge of the existence of an innovation can create motivation for its adoption (Rogers,

1983). Therefore, knowledge was operationalized as the amount of adequate information acquired by the rural women on various aspects of biogas technologies.

A comprehensive close ended schedule was prepared in consultation with relevant literature including general information on biogas, working principles, constructional details, functioning maintenance, importance and advantages of biogas, pre-requisites for installation and recommendations needed for biogas plants.

For assessing the knowledge, a test situation was provided to the respondents. They were asked to answer the questions related to biogas technology under four headings namely biogas stove, manure production, biogas fuel engine and biogas lighting. Multiple-choice questions were given. Respondents had to tick the right answer. For each correct answer a score of 1 was assigned, while for in correct answer a score of 0 was assigned. There were such questions also which had more than one answer. There were thirty questions under biogas stove, twenty-six questions under manure production, twenty-five questions under biogas fuel engine and twenty-two questions under biogas lighting.

Knowledge scores obtained by respondents were aggregated technology wise as well as overall knowledge.

Data gathering procedure and statistical technique used

This part comprises of the following sub-parts.

- (i) Data collection and procedure
- (ii) Period of investigation and
- (iii) Statistical techniques used

(i) Data collection and procedure

The necessary evidences were collected in line with the objectives of the study. The total samples of 200 rural households were individually approached by the researcher. By contacting each respondent personally the rural households were interviewed with the help of instrument developed in advance and pre-tested.

Keeping in view the convenience of the rural households several visit were made for the collection of the data during the course of investigation. Every care was taken for maintaining accuracy of implementation and wherever possible suitable cross checking was done.

During collection of the data the help from V.D.O. was also obtained. The secondary data wherever needed were obtained from the records of the district and block headquarters.

Period of investigation

The data collection was initiated during one year.

Statistical tools

The following statistical techniques have been applied in the analysis of data :-

(A) Percentage

$$\text{Percentage} = \frac{\text{The sum of all the responses}}{\text{Total number of all the responses}} \times 100$$

B) Arithmetic average

The arithmetic average mean of a variable is obtained by dividing the sum of its given values by their number. If the variable is denoted by X and if n values of X are given X_1, X_2, \dots, X_n , then the arithmetic mean of X is –

$$\bar{X} = \frac{\sum_{i=1}^n X_i}{n}$$

Correlation

The correlation between two variables, in which one is dependent on other, was calculated by product moment method, which is as :

$$r = \frac{\text{Cov. (X.Y)}}{\sqrt{\text{Var. (X). Var (Y)}}}$$

Standard deviation (S.D.)

It is defined as the square root of the means of the squares of the deviations taken from arithmetic mean –

$$(i) \text{ For ungrouped data – S.D.} = \sqrt{1/n \sum (\sum X_i - \bar{X})^2}$$

$$(ii) \text{ For grouped data – S.D.} = \sqrt{1/n \sum f_i - (X_i - \bar{X})^2}$$

Attitudinal gain

Post-exposure scores – Pre-exposure scores = attitudinal gain

Knowledge

Pre-exposure knowledge level

It refers to technology wise total scores obtained by the respondents on knowledge inventory before the exposure through media packages on biogas technologies.

Post-exposure knowledge level

It refers to technology wise total scores obtained by the respondents on the same knowledge inventory after imparting the exposure through media package on biogas technologies.

Knowledge gain

Post-exposure scores – Pre-exposure scores = Knowledge gain

Acceptance

It refers to the sum total of the scores of attitudinal gain and knowledge gain in case of each technology, as follows :

Acceptance of biogas stove (Z_1) = Attitudinal gain + knowledge gain in case of stove

Acceptance of manure production (Z_2) = Attitudinal gain + knowledge gain in case of manure production

Acceptance of biogas fuel engine (Z_3) = Attitudinal gain + knowledge gain in case of biogas lighting.

Acceptance of biogas lighting (Z_4) = Attitudinal gain + knowledge gaining case of biogas lighting.

Overall acceptance

It refers to the sum total of the acceptance scores of all the four technologies namely, biogas stove, manure production, biogas fuel engine and biogas lighting, i.e.,

Overall acceptance (Z) = Acceptance scores of biogas stove
 + Acceptance scores of manure production
 + Acceptance scores of biogas fuel engine
 + Acceptance scores of biogas lighting

Therefore,

$$Z = Z_1 + Z_2 + Z_3 + Z_4$$

Weighted scores

The average which is calculated on the basis of weights and coding

If X_1, X_2, \dots, X_k are the codes

and W_1, W_2, \dots, W_k are respective weights then

$$\text{Weighted mean} = \frac{W_1X_1 + W_2X_2 + \dots + W_kX_k}{W_1 + W_2 + W_3 + \dots + W_k}$$

$$= \frac{\sum wX}{\sum w}$$



Findings
and
Discussion 

Chapter-V

FINDINGS AND DISCUSSION

The empirical results and its discussion have been presented in this chapter. For the purpose of convenience the presentation has been sub-divided under the following heads :

1. To study the socio-economic profile of the respondents and households.
2. To assess the perception of rural families about applicability of non-conventional energy sources.
3. To assess the attitude of rural families in acceptance of non-conventional energy devices.
4. To identify the constraints in acceptance of non-conventional energy devices by rural families.
5. Suggest the suitable measures for removal of constraints faced by rural families in acceptance of non-conventional energy devices.

1. Profile of the respondent

Profile of the respondents was prepared and is presented in table 5.1 based on different personal socio-economic, communication and psychological factors.

Age

Age-wise distribution of respondents shows that 57.50 per cent respondents were of age group 36-50 years, 33.00 per cent respondents between age-group 20-35 years and 9.50 per cent respondents were belonged to 50 and above age group (Table 5.1).

Education

It is one of the important factors, which accelerates the knowledge of the respondents, it was observed in this study that 21.00 per cent respondents were not having that educational standard which is required at present time, 23.00 per cent were having education up to middle level and 18.00 per cent respondents were having education up to primary level (Table 5.1).

Caste

In rural areas, caste is an important social institution, in order to find out caste composition of respondents, the caste hierarchy of the study area was analysed. The results show that 38.00 per cent of the respondents were of OBC and 34.00 per cent were of SC. Only 28.00 per cent belonged to general caste.

Occupation

The Table 5.1 reveals that 37.50 per cent respondents were having agriculture labour, 34.00 per cent respondents were having caste occupation. Minimum 6.50 per cent respondents were having service.

Monthly income

The Table 5.1 indicates that 56.00 per cent respondents were earned Rs. 2000 to Rs. 4000 monthly and only 20.00 per cent respondents earned Rs. 4000 and above monthly. This shows that the families of respondents were not very financially sound.

Family type

It is evident from Table 5.1 that joint family system in rural areas is disintegrating into nuclear families. Though, joint family system has its own advantages but now-a-days most of the families prefer to live independently. There

were 61.00 per cent of total households under study were having nuclear families and 39.00 per cent were having joint families system.

Family size

The small family norm as propagated by the government has not been able to get adopted by rural mass, 60.00 per cent families have less than five members and 40.00 per cent families have more than five members (Table 5.1).

Land holding

The Table 5.1 reveals that 49.00 per cent households were having land up to 1 acre and 21.00 per cent respondents were having up to 3 acre.

Type of house

It was observed that 58.00 per cent of respondents resided in mixed type of house and 14.00 per cent respondents were resided in kachcha house (Table 5.1).

Herd size

The Table 5.1 reveal that 44.00 per cent respondents were possessing up to 2 animals and 29.00 per cent respondents were have not animals.

Social participation

The perusal of Table 5.1 reveals that 70.00 per cent respondents have no participation in any social organization whereas 24.00 per cent respondents were members of one social organization. This clearly points out the fact that rural women, generally, do not take part in social activities and keep themselves away from social institutions.

Material possession

Now-a-days, possession of modern household appliances and gadgets decide the standard of living. The Table 5.1 reveals that 63.00 per cent respondents were

possessed low materials category and 26.00 per cent were possessed medium materials category.

Communication variable

Table 5.1 shows that 45.50 per cent respondents have medium communicational variable followed by 44.00 per cent low communicational variables.

Psychological variable

Table 5.1 indicates that 43.00 per cent respondents showed low psychological variable followed by 37.00 per cent showed medium psychological variables.

Table 5.1 Socio-economic profile of households

Sl.No.	Attributes	Frequency	Per cent
1	Age (in years)		
	20 – 35	66	33.00
	35 – 50	115	57.50
	50 and above	19	9.50
2.	Education		
	Illiterate	42	21.00
	Can read only	33	16.50
	Primary	36	18.00
	Middle	46	23.00
	High School	29	14.50
	Graduate & above	14	7.00
3.	Caste		
	General	56	28.00
	O.B.C.	76	38.00
	SC/ST	68	34.00

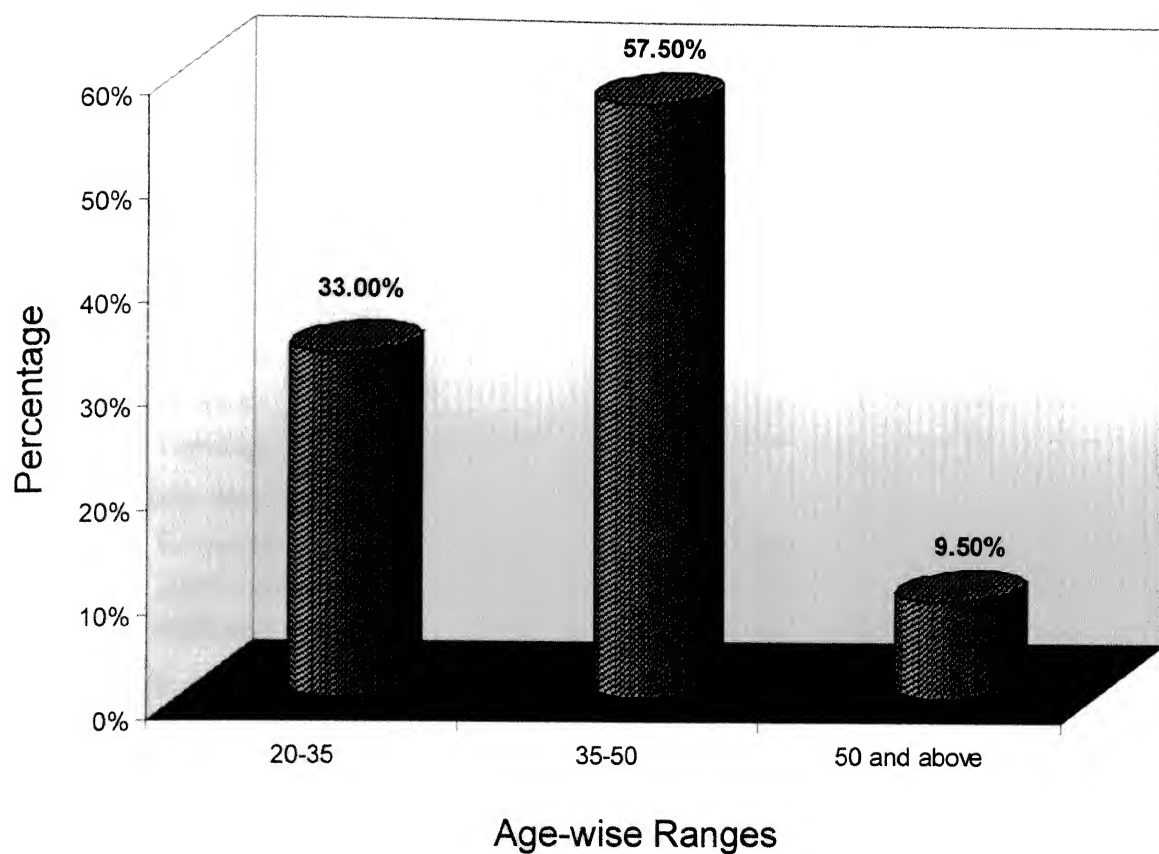


Fig. No. 5.1: Age-wise distribution of the selected respondents

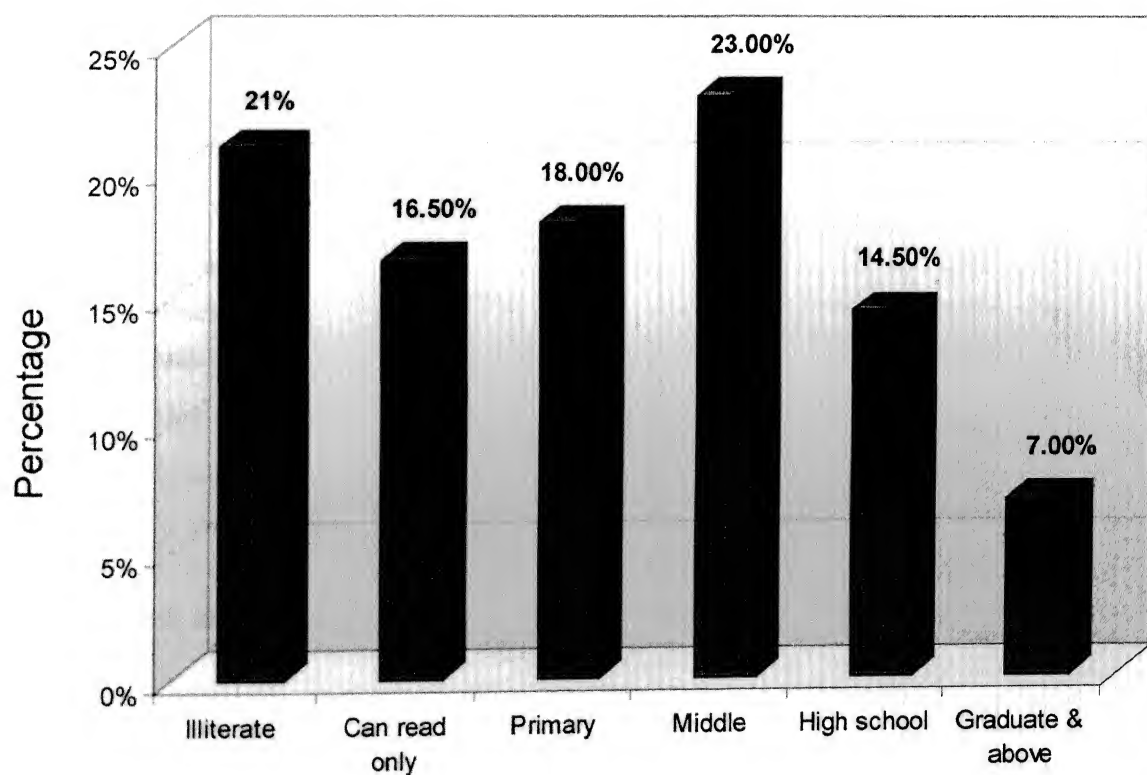


Fig. No. 5.2: Family education of selected respondents

4.	Occupation		
	Agricultural labour	75	37.50
	Caste occupation	68	34.00
	Business	22	11.00
	Service	13	6.50
	Farming	22	11.00
5.	Monthly income (Rs)		
	Below 2000	48	24.00
	2000 – 4000	112	56.00
	4000 and above	40	20.00
6.	Land holding		
	No land	28	14.00
	Up to 1 acre	118	49.00
	Up to 3 acres	42	21.00
	More than 3 acres	12	6.00
7.	Family type		
	Nuclear	122	61.00
	Joint	78	39.00
8.	Family size		
	Below 5 members	122	60.00
	Above 5 members	78	40.00
9.	Type of house		
	Kachcha	28	14.00
	Mixed	116	58.00
	Pucca	56	28.00
10.	Herd size		
	No animal	58	29.00
	Up to 2 animals	88	44.00
	3 – 4 animals	38	19.00
	5 & above animals	16	8.00

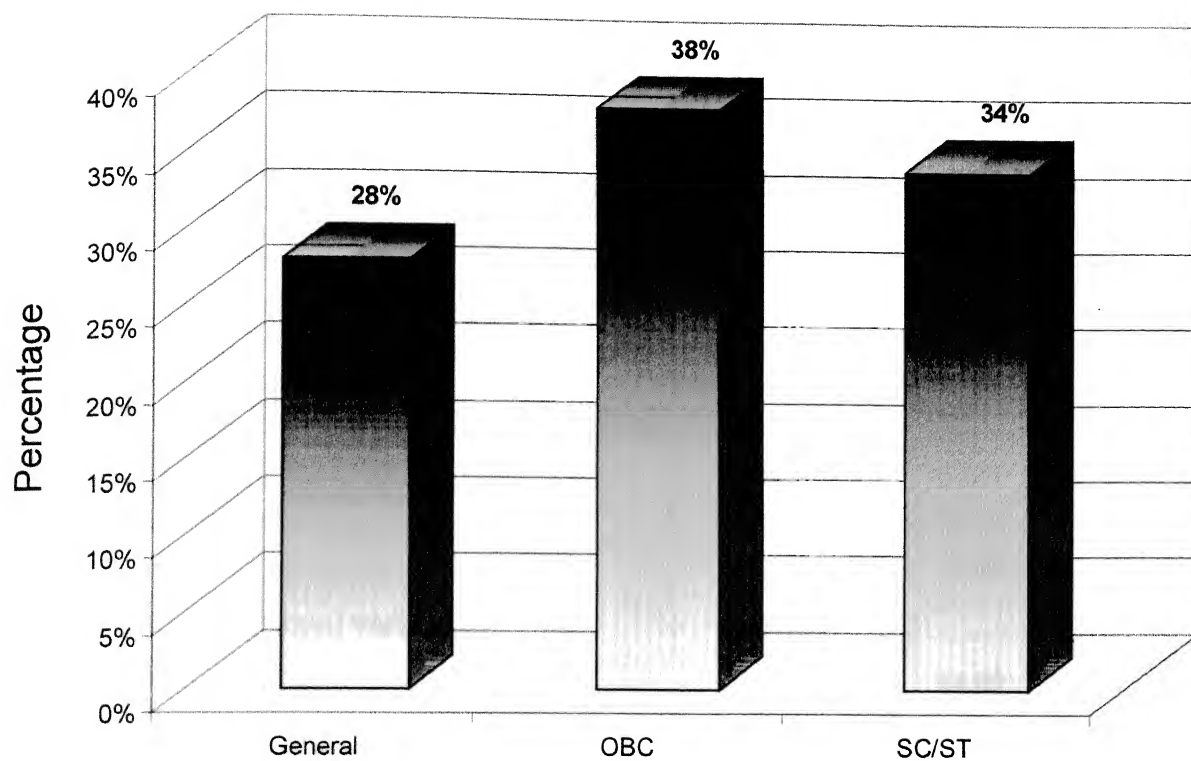


Fig. No. 5.3: Caste-wise distribution of the selected respondents

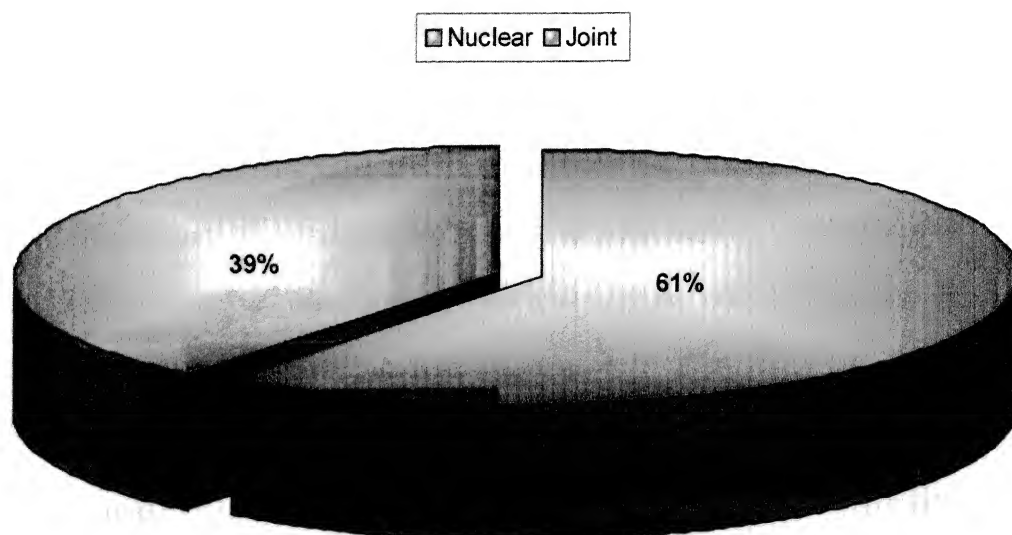


Fig. No. 5.4: Family type of selected respondents

11.	Social participation		
	Member of no organization	140	70.00
	Member of one organization	48	24.00
	Member of more than one organization		
12.	Material possession		
	Low	126	63.00
	Medium	52	26.00
	High	22	11.00
13.	Communicational variables		
	Low	88	44.00
	Medium	91	45.50
	High	21	10.50
14.	Psychological variable		
	Low	86	43.00
	Medium	74	37.00
	High	40	20.00

Awareness of non-conventional energy devices (NCEDs)

Table 5.2 shows the distribution of respondents according to their awareness about different non-conventional energy devices.

It was found that almost all the respondents who were aware of biogas followed by 35.00 per cent who were aware of 'Smokeless chulha'. It was also observed that 12.00 per cent respondents were aware of solar lantern, 16.00 per cent of solar cooker, 2.00 per cent of solar water heater and 4.00 per cent of wind mill. It was also found that none of the respondent was aware of solar dryer and solar refrigerator. Therefore, these two devices were not included in the tables.

Sethi and Singal (1993) also observed similar results and reported 93.04 per cent women were aware of biogas, 70.0 per cent of smokeless chulha and 61.00 per cent pressure cooker and 45.0 per cent of solar cooker.

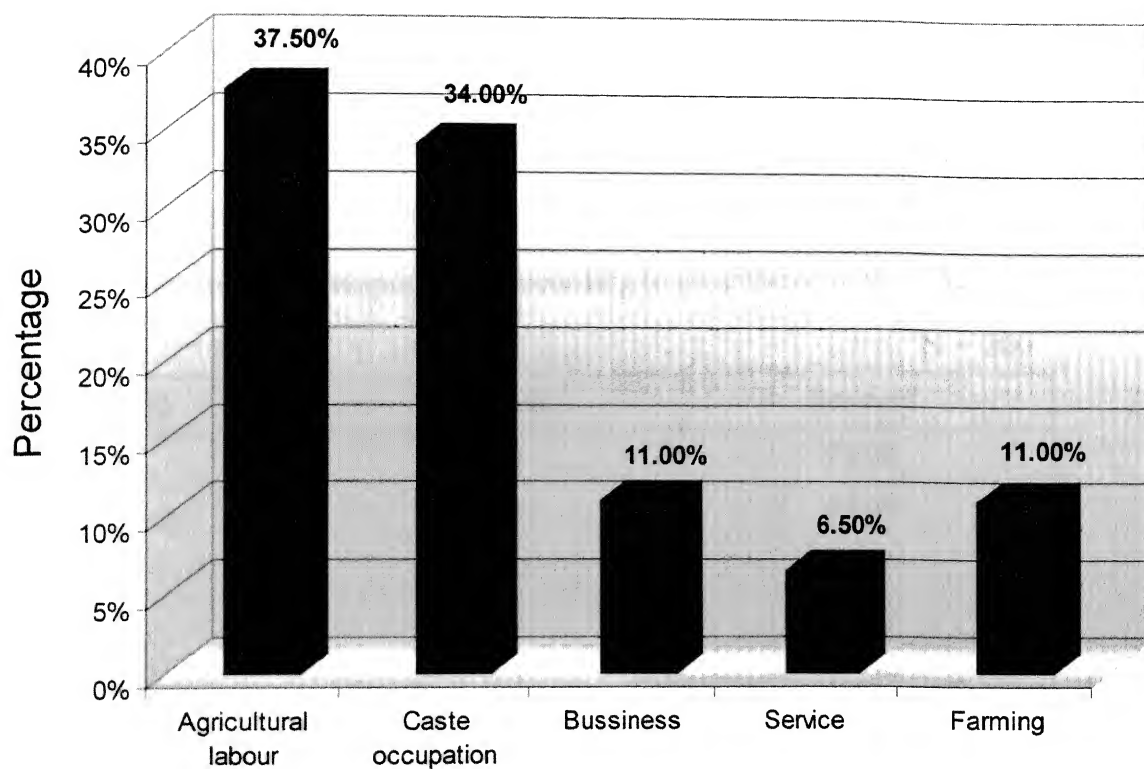


Fig. No. 5.5: Family occupation-wise selected respondents

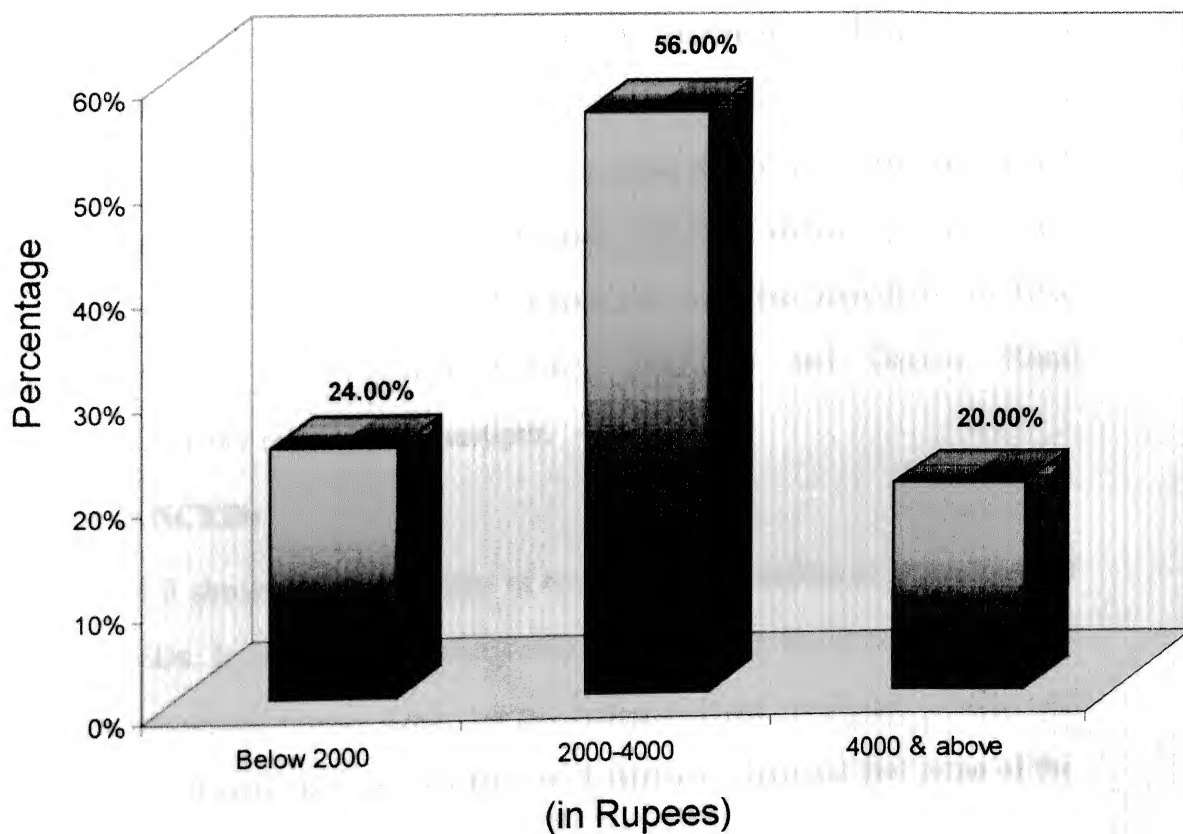


Fig. No. 5.6: Income-wise selected respondents

Ghosh (1991) also found that the better-known sources were biogas and solar heat while less known ones include wind energy and hydro-electric power.

Table 5.2. Distribution of respondents according to awareness of NCEDs

N = 200

Name of NCED	Frequency	Per cent
Biogas	184	92.00
Smokeless chulha	70	35.00
Solar cooker	32	16.00
SPV system	2	1.00
Solar lantern	23	11.50
Wind mill	8	4.00
Solar water heater	4	2.00

It is evident from the above findings that in comparison to other NCEDs. Biogas is one of the most known technologies among the selected respondents. In Bihar state, out of all the technologies on NCEDs, maximum work has been done on Biogas. Rajendra Agricultural University (RAU) has also undertaken extensive and intensive work on Biogas, which has also made the people aware of it much more than any other NCED. Next to biogas, which is known by half of the respondents in smokeless chulha as in this area also work has been done by Bihar Renewable Energy Development Agency (BREDa) and District Rural Development Agency (DRDA), Samastipur.

Possession of NCEDs

Table 5.3 shows the distribution of respondents according to possession of different NCEDs. It is clear from the Table 5.3 that only 18.00 per cent of the respondents possessed biogas. Only 5.0 per cent possessed smokeless chulha and only 2.00 per cent were having solar lantern. It was also observed that none of the

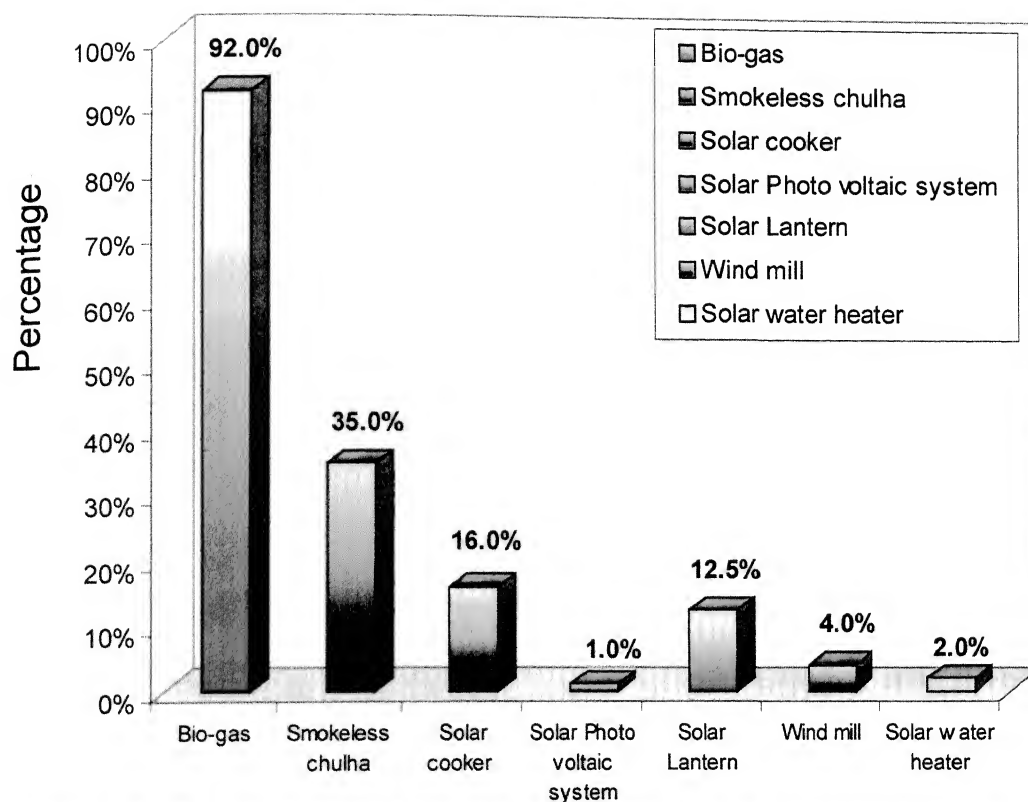


Fig. No. 5.7: Distribution of respondents according to awareness of non-conventional energy devices (NCEDs)

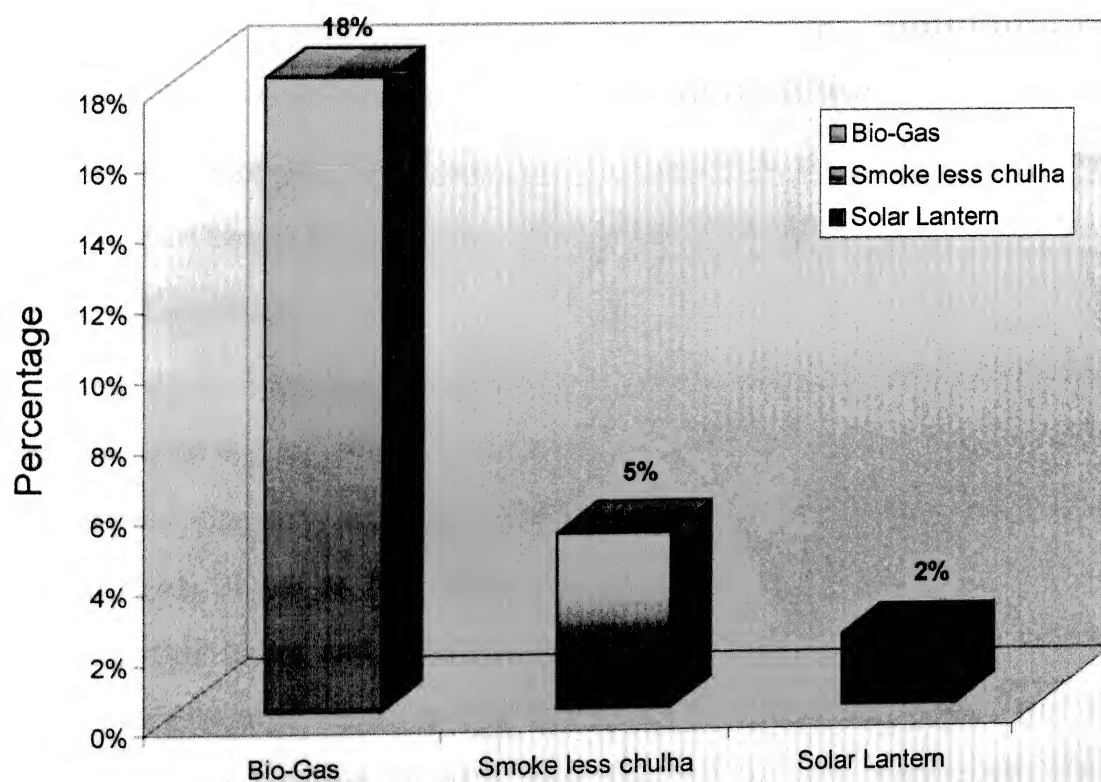


Fig. No. 5.8: Distribution of respondents according to possession of non-conventional energy devices (NCEDs)

respondents possessed the rest of the NCEDs like solar cooker, SPV system, solar dryer, wind mill, solar water heater and solar refrigerator. Therefore, these devices were not included in the Table 5.3. Similar findings were reported by Kumar *et al.* (1991) and Bhat *et al.* (1991). The literature has also supported that out of the other NCEDs, biogas has been possessed by maximum people. This finding course to prove that there has been efforts by the government and non-governmental organizations in making the subsidy and other facilities available to the people to make them install biogas plants more than any other devices.

Table 5.3. Distribution of respondents according to possession of non-conventional energy devices (NCEDs)

N = 200

Name of NCED	Frequency	Per cent
Biogas	36	18.00
Smokeless chulha	10	5.00
Solar lantern	4	2.00

Perception of applicability of non-conventional energy devices

Table 5.4 shows the distribution of respondents according to perceived applicability of biogas for homestead and farmstead activities.

Homestead activities

Among the homestead activities with regard to cooking operations, the table clearly revealed that majority of the respondents (69.0 %) perceived biogas as fully applicable for water heating. It was followed by 54.0, and 50.0 per cent respondents who perceived biogas as fully applicable for boiling milk/making tea, cooking kheer/preparing halwa and preparing pakora respectively. While 32.0 per cent respondents perceived biogas as fully applicable for roasting groundnut/roasting spices. This was followed by 14.0, 12.0 and 12.0 per cent respondents who

perceived biogas as fully applicable for preparing chapati, preparing dal and cooking rice respectively. Only 8.0 per cent respondents perceived it as fully applicable for preparing vegetable.

57.0 per cent respondents perceived biogas as partially applicable for preparing vegetables. It was followed by 49.0, 44.0 and 40.0 per cent respondents, who perceived biogas as partially applicable for cooking rice, preparing dal and preparing chapati respectively, followed it. While 30.0 per cent respondents perceived biogas as partially applicable for roasting spices/roasting groundnut. Only 9.0 per cent respondents perceived biogas as partially applicable for water heating. With regard to flour milling operation, it was found that majority of respondents were not aware of flour milling application of biogas. It was also found that 14.0 per cent respondents were not aware of lighting application of biogas.

Farm stead activities

Among the farm stead activities, with regard to manure production, 41.50 per cent respondents perceived biogas as partially applicable followed by 28.00 per cent respondents who perceived it as fully applicable while only 2.00 per cent respondents were not aware of its application in manure production.

For rest of the farming activities namely pumping, ploughing and chaff cutting majority of the respondents i.e. (94.0 %) were not aware of applicability of biogas. It was also observed that none of the respondents perceived it as fully applicable for pumping, ploughing and chaff cutting. It can concluded that biogas was applicable more in homestead activities as compared to farmstead activities. Among the home stead activities the applicability of biogas was higher for different 'cooking' operations than 'lighting' and 'flour milling'. Among the cooking operations according to maximum of the respondents biogas was fully applicable

Table 5.4 Distribution of respondents according to perception of applicability of biogas

N=200

Perceived applicability	Homestead activities										Farmstead activities			
	Cooking							Flour milling	Lighting	Manure production	Pumping	Ploughing	Chaff cutting	
	Boiling milk/ tea	Preparing chapati	Preparing vegetables	Preparing dal	Cooking rice	Cooking kheer	Roasting groundnut							Water heating
Fully applicable	108 (54.0)	28 (14.0)	16 (8.0)	24 (12.0)	24 (12.0)	90 (45.0)	64 (32.0)	138 (69.0)	- (0.5)	1 (0.5)	56 (28.0)	-	-	-
Partially applicable	62 (31.0)	80 (40.0)	114 (57.0)	88 (44.0)	98 (49.0)	84 (42.0)	60 (30.0)	18 (9.0)	1 (0.5)	168 (84.0)	83 (41.5)	4 (2.0)	2 (1.0)	2 (1.0)
Not at all applicable	6 (3.0)	54 (27.0)	46 (23.0)	64 (32.0)	54 (27.0)	2 (1.0)	52 (26.0)	20 (10.0)	7 (3.5)	3 (1.5)	2 (1.0)	11 (5.5)	10 (5.0)	10 (5.0)
Not aware of the applicability	24 (12.0)	38 (19.0)	24 (12.0)	24 (12.0)	24 (12.0)	24 (12.0)	24 (12.0)	192 (96)	25 (12.0)	28 (14.0)	59 (29.5)	188 (94.0)	188 (94.0)	188 (94.0)

(Figures in parentheses indicates percentage)

for water heating, boiling milk, making tea, cooking kheer, roasting groundnut and roasting spices while it was partially applicable for preparing vegetable, cooking rice and preparing chapati. Majority of respondents perceived that biogas was partially applicable for lighting. Among the farmstead activities least number of the respondents perceived biogas as partially applicable for 'manure production', while more than 90.0 per cent of the respondents were not aware of rest of the farmstead activities namely pumping, ploughing and chaff cutting.

These findings get the conformity of Chatterjee *et al.* (1991), Manjappa (1990) and Chole (1990) who found that majority of the respondents used biogas for cooking purposes and a small number of them used biogas for lighting or in emergency conditions, it was used for lighting purpose. The reasons for such trend might be that for those household cooking operations which require comparatively less time and less fuel like boiling milk, making tea, roasting groundnut, roasting spices and water heating biogas all the time i.e. fully most of the respondents preferred to use applicable due to its limited stores. According to the respondents, they are so accustomed to traditional devices that they find them more comfortable to use than biogas. Foods cooked on biogas specially chapati and vegetables are not of taste of which they are habitual. Therefore, they mentioned that biogas was partially applicable for these activities. The purpose of household lighting was also not fulfilled to the fuller extent since lighting is required for longer duration and availability of biogas is limited. All the biogas generated was perceived to be used for cooking because they give first priority to cooking and lighting was secondary application. Thus, for lighting biogas was perceived as partially applicable by majority of the respondents. For manure production, more than half of the respondents perceived biogas as partially applicable. Because, according to

respondents, the quality of slurry would not be sufficient for the total land and they will have to use some other manure besides slurry.

With regard to flour milling, pumping, ploughing and chaff cutting, the respondents expressed that the officers concerned with biogas have not communicated them that biogas can be used for flour milling, pumping, ploughing and chaff cutting besides cooking, manure production and lighting. Therefore, majority of the respondents were not aware of these applications of biogas.

I. Smokeless chulha

Table 5.5 clearly indicates that more than 70.0 per cent of the respondents were not aware of applicability of smokeless chulha. The table revealed that 30.0 per cent perceived smokeless chulha as fully applicable for water heating, while 17.0, 16.0, 16.0 and 15.0 per cent respondents perceived it as fully applicable for activities namely preparing chapati, roasting spices, preparing kheer and roasting groundnut respectively. It can be concluded that smokeless chulha was applicable only for cooking operation under homestead activities. More than 70.0 per cent of the respondents were not aware of applicability of smokeless chulha. Respondents who were not aware of smokeless chulha expressed that no body contacted them for installing this type of chulha.

Further respondents who perceived smokeless chulha as partially applicable felt that it was slow and inconvenient to use for preparing rice, dal and vegetables which partially are required in large amount every day, smokeless chulha was applicable. Respondents also reported that large sized chapatis, which they are habitual to make, can not be cooked well on the smokeless chulha due to its lower entry position. It seems that in this area not much work has been done on smokeless

Table 5.5 Distribution of respondents according to perception of applicability of smokeless chulha

N=200

Perceived applicability	Homestead activities (Cooking)									
	Boiling milk	Making tea	Preparing chapati	Preparing vegetable	Preparing dal	Cooking rice	Cooking kheer	Roasting groundnut	Roasting spices	Water heating
Fully applicable	42 (21.0)	42 (21.0)	34 (17.0)	32 (16.0)	34 (17.0)	38 (19.0)	32 (16.0)	30 (15.0)	32 (16.0)	60 (30.0)
Partially applicable	18 (9.0)	18 (9.0)	26 (13.0)	28 (14.0)	26 (13.0)	22 (11.0)	28 (14.0)	30 (15.0)	2 (1.0)	-
Not at all applicable	-	-	-	-	-	-	-	-	6 (3.0)	-
Not aware of the applicability	140 (70.0)	140 (70.0)	140 (70.0)	140 (70.0)	140 (70.0)	140 (70.0)	140 (70.0)	140 (70.0)	140 (70.0)	140 (70.0)

(Figures in parentheses indicates percentage)

chulhas. The rural families still accustomed to using traditional chulha. There are very few families who have the exposure of using the smokeless chulha.

II. Solar cooker

Table 5.6 shows the distribution of respondents according to perception of applicability of solar cooker. The Table 5.6 clearly indicated that a majority of respondents were not aware of the applicability of solar cooker. Among those who were aware only 1.0 per cent respondents perceived solar cooker as fully applicable for roasting groundnut, while 8.0 and 7.0 per cent respondents perceived solar cooker as partially applicable for cooking rice and dal. While only 1.0 per cent respondents perceived it as partially applicable for baking cake and biscuits. It can be concluded that solar cooker was used exclusively for cooking purposes under homestead activities. Majority of the respondents were not aware of applicability of solar cooker. Maximum respondents perceived that it was partially applicable for preparing dal and cooking rice and it was not at all applicable for rest of the cooking activities namely preparing vegetable, cooking kheer, roasting groundnut and baking cakes and biscuits.

Similar findings were reported by Kaushik and Verma (1994). The agencies concerned with NCED have not give much emphasis to popularize solar cooker in the area of investigation. This was the main reason of low awareness about solar cooker. Solar cooker was perceived as partially applicable and not at all applicable by the respondents. The reasons told by them were that on solar cooker, cooking is slow. It is a time consuming process which does not fit to routine a eating habit. The required amount of foods can not be cooked because of small size of container. Also, the taste of foods cooked in solar cooker was not according to existing taste. Chapati cannot be made in solar cooker. In Bihar, the combination of food is such

Table 5.6 Distribution of respondents according to perception of applicability of solar cooker

N=200

Perceived applicability	Homestead activities (Cooking)					
	Preparing vegetable	Preparing dal	Cooking rice	Cooking kheer	Roasting groundnut	Baking cake & biscuits
Fully applicable	-	-	-	-	2 (1.0)	-
Partially applicable	6 (3.0)	14 (7.0)	16 (8.0)	8 (4.0)	-	2 (1.0)
Not at all applicable	26 (13.0)	18 (9.0)	16 (8.0)	24 (12.0)	30 (15.0)	32 (16.0)
Not aware of the applicability	168 (84.0)	168 (84.0)	168 (84.0)	168 (84.0)	168 (84.0)	168 (84.0)

(Figures in parentheses indicate percentage)

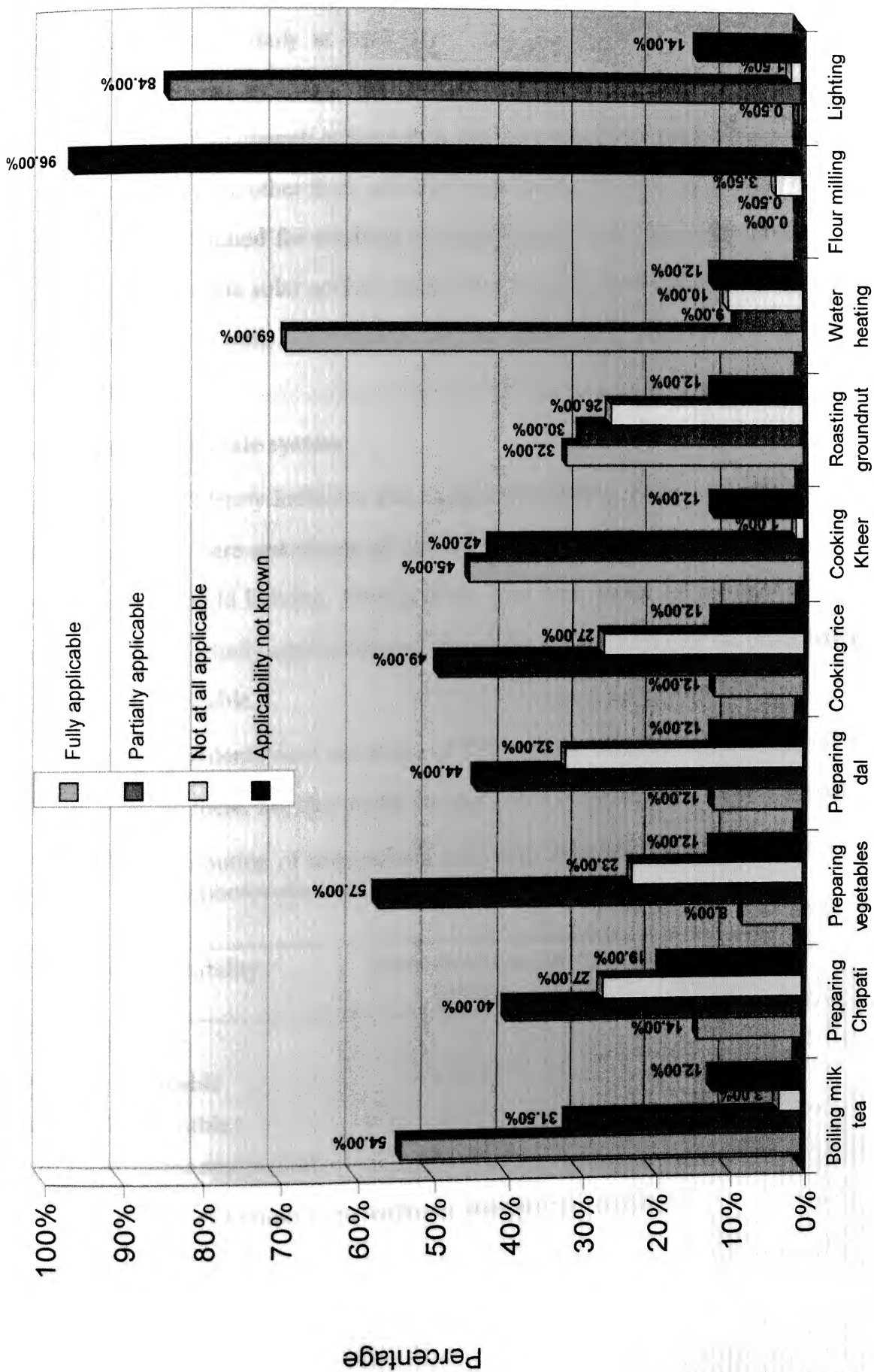


Fig. No. 5.9: Perceived applicability of bio-gas (Homestead activities)

that chapati is eaten daily at least once. Thus, people have to use some other medium for chapati making. People think that once they had to use another traditional device for chapati making then why they should not cook all the items on that device only. The other thing was that the respondents cooking on solar cooker have to be little trained for cooking in an appropriate way. Moreover because of seasonal variation the solar cooker can not be used effectively throughout the year. All these factors were responsible for not perceiving solar cooker as fully applicable.

III. Solar photovoltaic system

Table 5.7 clearly indicates that under home stead activity, majority of (96.0 %) respondents were not aware of the applicability of solar photovoltaic system (SPV) for household lighting. Among those who were aware 1.0 per cent of them perceived it as partially applicable and rest of the respondents (3.0 %) perceived it as not at all applicable.

The respondents were not aware of SPV system. They had not seen any SPV system installed there. So, they could not perceive the applicability of SPV system.

Table 5.7. Distribution of respondents according to perception of applicability of solar photovoltaic (SPV) system

N = 200

Perceived applicability	Homestead activity lighting	Farmstead activity pumping
Fully applicable	-	-
Partially applicable	2 (1.0)	-
Not at all applicable	6 (3.0)	-
Not aware of the applicability	192 (96.0)	200 (100.0)

(Figures in parentheses indicated percentage)

IV. Wind mill

It is evident from the Table 5.8 that majority of the respondents (95.0 %) were not aware of the applicability of wind mill for home stead and farm stead activities namely flour milling and pumping. It can be concluded that more than 95.0 per cent of the respondents were not aware of applicability of windmill and almost all the aware respondents perceived it is not at all applicable for flour milling and pumping. The respondents had not seen any wind mill installed in that area. A large percentage of people were not aware of this device. Some of the respondents who knew about wind mill, they had not observed it working in their own village, therefore, and they perceived it as not at all applicable.

Table 5.8. Distribution of respondents according to perception of applicability of wind mill

N = 200

Perceived applicability	Homestead activity Flour milling	Farmstead activity pumping
Fully applicable	-	-
Partially applicable	2 (1.0)	-
Not at all applicable	8 (4.0)	10 (5.0)
Not aware of the applicability	190 (95.0)	190 (95.0)

(Figures in parentheses indicated percentage)

V. Solar lantern

It is evident from Table 5.9 that majority (93.0 %) of the respondents were not aware of the applicability of solar lantern. Among those, who were aware 2.0 per cent of them perceived it as partially applicable for homestead activity. It can be concluded that solar lantern is exclusively applicable for homestead activity namely lighting. Much progress has not been reported in the field of solar lantern by the concerned agencies. Majority of the respondents were not aware of this device.

Respondents who were aware reported that solar lantern was partially applicable because of its large dependence on sun.

Table 5.9. Distribution of respondents according to perception of applicability of lantern

N = 200

Perceived applicability	Homestead activity lighting
Fully applicable	-
Partially applicable	4 (2.0)
Not at all applicable	10 (5.0)
Not aware of the applicability	186 (93.0)

(Figures in parentheses indicated percentage)

VI. Solar water heater

Table 5.10 shows that the distribution of respondents according to perception of applicability of solar water heater. It is clear from the Table that majority (96.0%) of the respondents were not aware of its applicability for homestead activity namely water heating. Among those who were aware 1.0 per cent respondents perceived it as partially applicable. There was not even a single solar water heater installed in the area of investigation. Therefore, majority of the (96.0 %) respondents were not aware of this device.

Table 5.10. Distribution of respondents according to perception of applicability of Solar water heater

N = 200

Perceived applicability	Homestead activity lighting
Fully applicable	-
Partially applicable	2 (1.0)
Not at all applicable	6 (3.0)
Not aware of the applicability	192 (96.0)

(Figures in parentheses indicated percentage)

Present traditional devices used

Homestead activities

A perusal of the Table 5.11 indicates that under homestead activities with regard to cooking operation 90.0 per cent respondents were using firewood chulha followed by 56.0 per cent respondents using cow dung cake chulha. It was followed by 24.0 per cent respondents were using coal chulha and 30.0 per cent were using kerosene oil stove. While only 15.0 per cent respondents were using LPG stove.

With regard to household lighting, it was found that all the respondents (100.0 %) were using kerosene oil lantern and only 26.0 per cent respondents were using electric devices.

Farmstead activities

Under farmstead activities, the Table clearly revealed that with regard to pumping operation, majority of the respondents (97.0 %) were using natural device (rain water) followed by 39.0 per cent respondents using diesel pumpset while only 12.0 per cent respondents were using electric pump. With regard to activity namely chaff cutting, majority of the respondents 95.0 per cent were using manual chaff cutter followed by 16.0 per cent respondents who were using diesel chaff cutter while only 2.0 per cent respondents were using electric chaff cutter.

Similar pattern were observed by Patil (1980), Bhatnagar *et al.* (1991), Tawade and Panmare (1990), Bhat *et al.* (1991), Kumar *et al.* (1991) and Joshi *et al.* (1992) who reported that traditional devices based on firewood, agricultural waste and dung cake were mainly used for domestic cooking.

Differential attitude towards acceptance of biogas technology

Table 5.12 shows the distribution of respondents according to attitude towards acceptance of biogas technologies, so the data on attitude towards

Table 5.11 Distribution of respondents used traditional devices

Activities	Homestead activities			Farmstead activities		
	Traditional	Frequency	Percentage	Activities	Traditional	Percentage
Cooking	Kerosene stove	60	30.0	Pumping	Natural (Rainwater)	97.0
	Cow dung cake chulha	112	56.0		Diesel pump	39.0
	Firewood chulha	180	90.0		Electric pump	12.0
	Cool Chulha	48	24.0		Animal driven	99.0
	LPG stove	30	15.0		Power tiller	9.0
Lighting	Kerosene lantern	200	100.0	Ploughing Tractor	Manual chaff cutter	95.0
	Electric devices	52	26.0		Diesel chaff cutter	16.0
Flour milling	Diesel mill	196	98.0	Chaff cutting	Electric chaff cutter	2.0
	Electric mill	45	22.5		Compost	100.0
					Bio-fertilizer	7.0
				Manure production		

acceptance was collected at pre-exposure as well as post exposure stage. The table clearly depicts that in case of biogas stove, slightly less than 95.0 per cent had "not at all favourable" attitude towards acceptance of biogas stove and rest of the respondents had "some what favourable" attitude towards acceptance of biogas stove before exposing media package on biogas stove to the respondents. But, at the post exposure stage it was seen that 72.0 per cent were having "some what favourable" attitude towards acceptance followed by 20.0 and 8.0 per cent respondents who had favourable and highly favourable attitude towards acceptance of biogas stove respectively. It was also observed that none of the respondents had "not at all favourable" attitude towards acceptance at post exposure stage.

It was observed that more than half per cent (60.0 %) had low attitudinal gain followed by 30.0 per cent respondents who had medium level of attitudinal gain while 10.0 per cent respondents had high level of attitudinal gain in case of biogas stove. With regard to manure production, it was found that before media exposure on manure production a majority of 81.0 per cent respondents had "not at all favourable" attitude and rest of the respondents had "some what favourable" attitude towards acceptance of manure production.

As far as biogas fuel engine was concerned, the table indicate that more than 90 per cent had "not at all favourable" attitude at pre-exposure stage and rest of the respondents 4.0 per cent had "some what favourable" attitude towards acceptance of biogas fuel engine. But after media exposure on biogas fuel engine, the level increased as 64.0 per cent respondents possessed "somewhat favourable" attitude followed by 20.0 and 16.0 per cent respondents having "favourable" and "highly favourable" attitude towards acceptance of biogas fuel engine. It was also observed that 69.0 per cent respondents had low level of attitudinal gain followed by 27.0 per

Table 5.12 Distribution of respondents according to differential attitude towards acceptance of biogas technologies

Technologies	Categories	Pre-exposure frequency	Post exposure frequency	Attitudinal gain	Frequency
Biogas stove	Not at all favourable	94 (94.0)	-	Low	60 (60.0)
	Somewhat favourable	6 (6.0)	72 (72.0)	Medium	30 (30.0)
	Favourable	-	20 (20.0)	High	10 (10.0)
	Highly favourable	-	8 (8.0)		
Manure production	Not at all favourable	90 (90.0)	-	Low	62 (62.0)
	Somewhat favourable	10 (10.0)	66 (66.0)	Medium	30 (30.0)
	Favourable	-	18 (18.0)	High	8 (8.0)
	Highly favourable	-			
Biogas fuel engine	Not at all favourable	96 (96.0)	-	Low	69 (69.0)
	Somewhat favourable	4 (4.0)	64 (64.0)	Medium	27 (27.0)
	Favourable	-	20 (20.0)	High	4 (4.0)
	Highly favourable	-	16 (16.0)		
Biogas lighting	Not at all favourable	84 (84.0)	-	Low	70 (70.0)
	Somewhat favourable	16 (16.0)	64 (64.0)	Medium	27 (27.0)
	Favourable	-	22 (22.0)	High	3 (3.0)
	Highly favourable	-			

(Figures in parentheses indicates percentages)

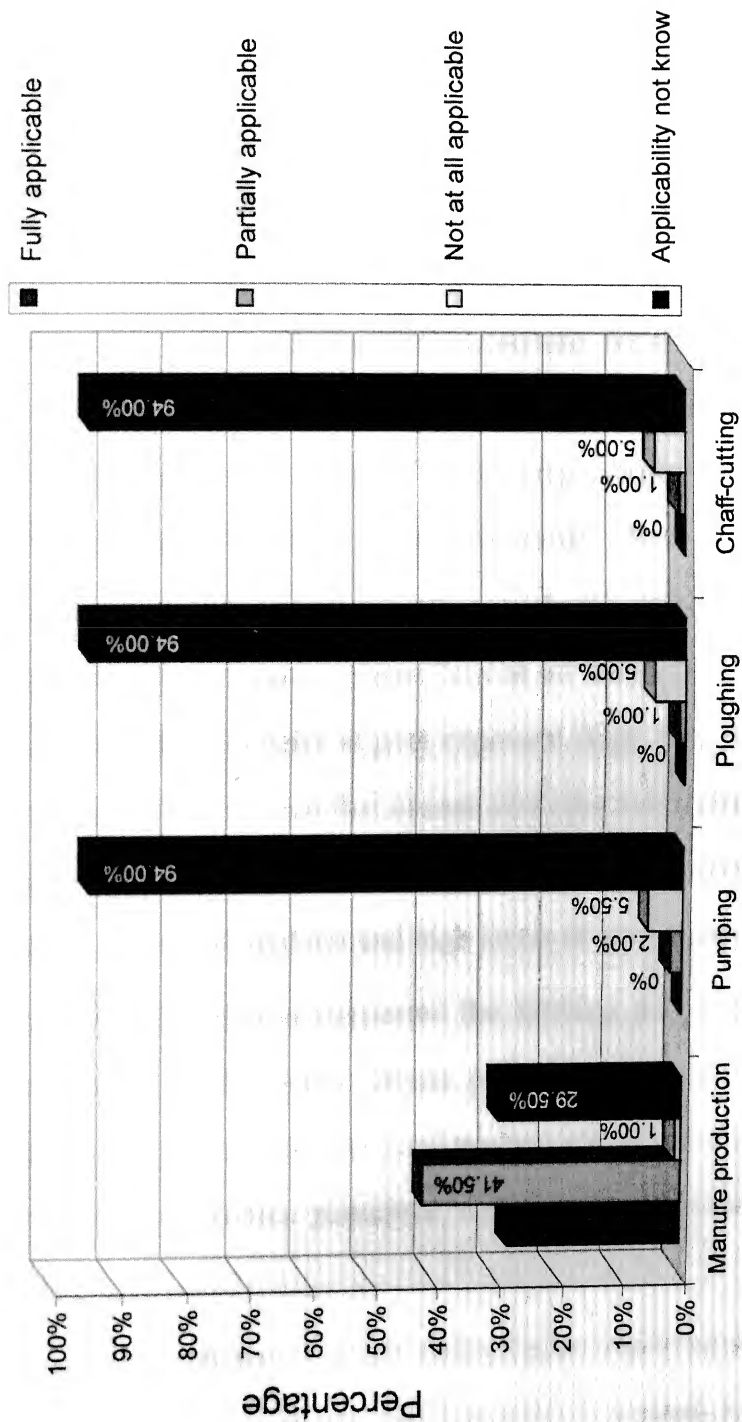


Fig. No. 5.10: Perceived applicability of bio-gas (Farmstead activities)

cent, who had medium level of attitudinal gain and only 4.0 per cent respondents had high level of attitudinal gain in case of biogas fuel engine.

It was observed that with regard to biogas lighting, 70.0 per cent respondents had low level of attitudinal gain, followed by 27.0 per cent respondents who had medium level of attitudinal gain while only 3.0 per cent respondents had high level of attitudinal gain.

It can be concluded that as a result of media – exposure, the attitudinal level towards acceptance of biogas technologies increased. Because, in case of all the four technologies, at pre-exposure stage, majority of the respondents were having “not at all favourable” followed by “somewhat favourable”. But after media exposure, majority of the respondents were having “some what favourable” attitude and none of the respondents was found to have “not at all favourable” attitude towards acceptance of biogas technologies at post exposure stage. But, there was not so much attitudinal gain, as it was seen that in case of all the four technologies, majority of the respondents had low level of attitudinal gain towards acceptance and comparatively lesser percentage had medium and high levels of attitudinal gain.

Chahal and Malaviya (1995) also supported the findings that majority of respondents had low attitude level towards biogas plants. Kaushik and Verma (1994) reported that the attitude of majority of rural women was found favourable for biogas and majority of rural women perceived high benefits with the use of biogas.

The attitude towards acceptance of biogas technologies improved after the exposure of media package, as it is a known fact that attitude towards any new technology requires mental acceptance of the technology.

In this particular case, biogas technologies are quite different from the normally used traditional technology. The rural households are accustomed to their own fixed traditional ways of conducting homestead and farmstead activities. A shift to new technologies, which require psychological and mental change is a slow process. The selected respondents had seen some of the technologies, but none of them had themselves used the technology.

II. Knowledge level of biogas technologies

Table 5.13 shows the distribution of respondents according to knowledge level of biogas technologies. Media package on biogas technologies were exposed to respondents. The estimation of the knowledge level was done technology wise at pre-exposure and post-exposure stage.

It is clear from Table 5.13 that at pre-exposure stage, in case of all the four technologies, all the respondents (100 %) obtained knowledge scores less than overall mean. But at the post exposure stage, in case of biogas stove 71.0 per cent respondents obtained knowledge scores less than overall mean and rest 29.0 per cent respondents obtained knowledge scores greater than overall mean.

With regard to manure production, it was found that majority of the respondents 52.0 per cent obtained knowledge scores greater than overall mean at post exposure stage and rest of the respondents obtained scores less than overall mean.

As far as biogas fuel engine was concerned, it was found that majority of the respondents 64.0 per cent obtained knowledge scores less than overall mean and rest 36.0 per cent respondents obtained knowledge scores greater than overall mean at post exposure stage.

Table 5.13 Distribution of respondents according to knowledge level of biogas technologies

Technologies	Category	Pre-exposure frequency	Post exposure frequency
Biogas stove	Knowledge score > overall mean	0	29 (29.0)
	Knowledge score < overall mean	100 (100.0)	71 (71.0)
Manure production	Knowledge score > overall mean	0	52 (52.0)
	Knowledge score < overall mean	100 (100.0)	48 (48.0)
Biogas fuel engine	Knowledge score > overall mean	0	36 (36.0)
	Knowledge score < overall mean	100 (100.0)	64 (64.0)
Biogas lighting	Knowledge score > overall mean	0	50 (50.0)
	Knowledge score < overall mean	100 (100.0)	50 (50.0)
Overall knowledge	Knowledge score > overall mean	0	51 (51.0)
	Knowledge score < overall mean	100 (100.0)	49 (49.0)

(Figures in parentheses indicate percentages)

In case of biogas lighting, almost equal percentage i.e. 50.0 and 50.0 per cent respondents obtained knowledge scores greater than overall mean and less than overall mean respectively.

If we look at the overall knowledge scores, it can be observed that at post exposure stage, more than half of the respondents (51.0 %) obtained scores greater than overall mean and rest of the respondents (49.0 %) obtained knowledge scores less than overall mean.

In this Table 5.13, knowledge gain has not been shown due to almost negligible pre-exposure knowledge score.

On the basis of these findings, it may be concluded that the pre-exposure knowledge of respondents for all the four technologies was less than overall mean and there was increase in knowledge of the respondents as a result of media exposure. The knowledge scores obtained by majority of respondents was more than overall mean in case of manure production which was followed by biogas lightings. Biogas stove and biogas fuel engine respectively at post-exposure stage.

However, Chahal and Malaviya (1995) found that majority of the respondents had low knowledge level of biogas plant.

The knowledge level of respondents regarding biogas technologies was very low because the field level functionaries and concerned officers had not imparted the knowledge of these technologies as reported by respondents. They only informed them about existence of biogas technologies and insisted them to install the biogas plant without imparting in depth knowledge.

However, after intensive media exposure, the knowledge level increased considerably with the help of charts, posters and videocassette they could attain knowledge regarding biogas technologies. Further, respondent's queries, confusions

and problems were removed by group discussion. Booklet distributed among respondents also supplement their knowledge and they could have a greater insight through the booklet with the help of their family members.

Sustained efforts in these aspects definitely motivate rural households for acceptance of the biogas technologies.

III. Acceptance of biogas technologies

Table 5.14 shows the distribution of respondents according to acceptance of biogas technologies.

Table 5.14. Distribution of respondents according to knowledge level of biogas technologies

Technologies	Categories	Frequencies	Per cent
Biogas stove	Low	48	48.0
	Medium	27	27.0
	High	25	25.0
Manure production	Low	56	56.0
	Medium	24	24.0
	High	20	20.0
Biogas fuel engine	Low	55	55.0
	Medium	28	28.0
	High	17	17.0
Biogas lighting	Low	59	59.0
	Medium	27	27.0
	High	14	14.0
All technologies combined	Low	49	49.0
	Medium	28	28.0
	High	23	23.0

It is clear from this table that with regard to biogas stove, it was found that majority of respondents (48.0 %) had low level of acceptance followed by 27.0 per

cent respondents having medium level of acceptance while only 25.0 per cent respondents had high level of acceptance.

In case of manure production, it was observed that more than half of the respondents (56.0 %) were having low level of acceptance followed by 24.0 and 20.0 per cent respondents who had medium and high level of acceptance respectively.

With regard to biogas fuel engine, it was found that majority of the respondents (55.0 %) had low level of acceptance followed by 28.0 per cent respondents having medium level of acceptance while only 17.0 per cent respondents had high level of acceptance.

As far as biogas lighting was concerned majority of the respondents (59.0 %) were having low level of acceptance followed by 27.0 per cent respondents having medium level of acceptance while only 14.0 per cent respondents had high level of acceptance.

With regard to the acceptance of all technologies combined, it was found that majority of the respondents (49.0 %) had low level of acceptance followed by 28.0 per cent respondents having medium level of acceptance. Only one fourth of the respondents (23.0 %) had high level of acceptance.

It can be concluded that among all the four technologies, biogas stove had maximum acceptance as the greater percentage i.e. 25.0 per cent respondents had acceptance of high level of biogas stove. It was followed by manure production, biogas fuel engine and biogas lighting in which 20.0, 17.0 and 14.0 per cent respondents had acceptance of high level respectively. However, there was not much variation in the percentage of respondents with regard to technology wise acceptance.

With regard to acceptance of all technologies combined, it was found that only one-fourth of the respondents (23.0 %) had high level of acceptance. Majority of the respondents (49.0 %) had low level of acceptance of biogas technologies.

These findings are in conformity of Chahal and Malaviya (1995), who found that perceived acceptability index of biogas was low for majority of the respondents.

Constraints perceived in acceptance of biogas technologies

Table 5.15 depicts the distribution of respondents according to perceived constraints in acceptance of biogas technologies.

In case of educational and communicational constraints, it was found that 55.0 per cent respondents obtained scores less than overall mean while 45.0 per cent respondents obtained scores more than overall mean.

In case of technical constraints, majority of the respondents (58.0 %) obtained more than overall mean scores and rest of the respondents (42.0 %) obtained less than overall mean scores.

With regard to operational constraints, majority of the respondents (58.0 %) obtained less than overall mean scores and others obtained more than overall mean scores.

With respect to socio-cultural constraints, majority of the respondents (56.0%) obtained less than overall mean scores and rest of the respondents (44.0 %) obtained more than overall mean scores.

In case of economic constraints, 58.0 per cent of respondents obtained more than overall mean and (42.0 %) less than overall mean scores.

Table 5.15 Distribution of respondents according to knowledge level of biogas technologies

Constraints	Category	Frequency	Percentage
Educational and communicational	Score obtained > overall mean	45	45.0
	Score obtained < overall mean	55	55.0
Technical	Score obtained > overall mean	58	58.0
	Score obtained < overall mean	42	42.0
Operational	Score obtained > overall mean	42	42.0
	Score obtained < overall mean	58	58.0
Socio-cultural	Score obtained > overall mean	44	44.0
	Score obtained < overall mean	56	56.0
Economic	Score obtained > overall mean	58	58.0
	Score obtained < overall mean	42	42.0
Organizational	Score obtained > overall mean	67	67.0
	Score obtained < overall mean	33	33.0
Total	Score obtained > overall mean	57	57.0
	Score obtained < overall mean	43	43.0

With respect to organizational constraints, it was found that a majority of respondents i.e. 67.0 per cent obtained more than overall mean scores and rest 33.0 per cent obtained less than overall mean scores.

With respect to total constraints, it was found that 57.0 per cent respondents obtained more than overall mean and rest of the respondents obtained less than overall mean scores.

After going through the table it can be concluded that organizational constraint was perceived by majority of the respondents. It was followed by situational, technical, economic, educational and communicational and socio-cultural constraints respectively. While operational constraint was perceived by minimum number of respondents.

Pathak (1985), Bhati (1985) and Agarwal and Arora (1989) also observed the similar results.

Ranking within the categories

(i) Educational and communicational constraints

Table 5.16 gives the distribution of respondents according to educational and communicational constraints. Under this, the most commonly felt constraint was "lack of effective communication between the field functionaries and rural women" and so ranked first. The second most important constraint perceived by the respondents was lack of sufficient knowledge about procedural issues involved in procurement of subsidy help.

It can be concluded that these were the field level functionaries, technical staffs and concerned agencies that were actually responsible for low acceptance of biogas.

Table 5.16 Distribution of respondents according to perceived constraints regarding educational and communicational problems in acceptance of biogas

N=100

S.No.	Constraints	Frequency	Percentage	Rank
1.	Lack of knowledge about govt. help in the form of subsidy	5	5.00	VIII
2.	Lack of sufficient knowledge about procedural issues involved in procurement of subsidy help	16	16.0	III
3.	Lack of effective communication between the field functionaries and rural women	25	25.0	I
4.	Lack of knowledge about advantages of having biogas plant	14	14.0	IV
5.	Lack of awareness about existence of biogas technology	-	-	-
6.	Inadequate information given by technical staffs regarding biogas plant	21	21.0	II
7.	Negative views of male members of the family towards biogas plant	7	7.0	VI
8.	Lack of proper publicity from agricultural deptts./nodal agencies	6	6.00	VII
9.	Lack of proper guidance from agricultural deptts./nodal agencies	10	10.00	V

Although the government and nodal agencies have implemented the biogas programme, it is the responsibility of grass root workers and linking system to provide adequate information and motivate the rural people to accept the innovation. They had not motivated the rural women and male members in a convincing manner. There seems to be communicational gap which has resulted in the above findings.

(ii) Technical constraints

Table 5.17 gives the distribution of respondents according to perceived technical constraints in acceptance of biogas. Under this, the most important perceived constraint, which was ranked, first was "complication in installation of gas plant". The second important perceived constraint was "reduced gas supply during winter" which was followed by "irregular gas supply" and so ranked third.

Table 5.17 Distribution of respondents according to perceived constraints regarding educational and communicational problems in acceptance of biogas

N = 100

S.No.	Constraints	Frequency	Percentage	Rank
1.	Difficulty in maintenance of biogas plants	10	10.00	IV
2.	Inability to calculate the quantity of dung required per day	8	8.00	V
3.	Ignorance about the technique of use of biogas plant	6	6.00	VI
4.	Rusting of gas holder	3	3.00	VII
5.	Accumulation of water in pipe line	3	3.00	VII
6.	Complication in installation of biogas plant	21.00	21.00	I
7.	Cracking of plant	8	8.00	V
8.	Reduced gas supply during winter	20	20.00	II
9.	Irregular gas supply	17	17.00	III
10.	Constraints of plants is difficult in water level areas	1	1.00	VIII

These findings are supported by Johal and Saini (1980), Maulik (1982), Patel and Patel (1984), Singh (1987) and Soundarapandiah (1992).

Before any innovation or technology is adopted, it seems very complex to the people. In the eyes of the respondents, they have to pass through a tedious and complicated procedure of arranging the fabrication materials and funds, dung etc.

for installation of gas plant. So "complication in installation of gas plant" was perceived most important majority of the respondents.

(iii) Operational constraints

It is evident from the Table 5.18 that under operational constraints, the first most important constraint perceived by the respondents was 'repairing facility is not available in the village'. The second, third and fourth important constraints perceived by the respondents were difficulty in regular cleaning of the pipe line, unavailability of spare parts and collection of the requisite amount of 'cow dung' respectively.

Table 5.18 Distribution of respondents according to perceived constraints regarding operational problems in acceptance of biogas

N=100

S.No.	Constraints	Frequency	Percentage	Rank
1.	Difficulty in regular cleaning of the pipeline	19	19.00	II
2.	Collection of the requisite amount of cow dung	16	16.00	IV
3.	Preparation of the inlet slurry	15	15.00	V
4.	Improper feeding	6	6.00	VI
5.	Unavailability of spare parts	17	17.00	III
6.	Shortage of fabrication material	5	5.00	VII
7.	Repairing facility is not available in the village	24	24.00	I

To conclude, lack of repairing facility, regular cleaning of pipeline unavailability of spare parts, and collection of the requisite amount of cow dung were the main operational constraints perceived by the respondents.

(iv) Socio-cultural constraints

The Table 5.19 clearly reveals that under socio-cultural constraints the constraint which was felt most important was 'habitual to work on traditional method and hence ranked first. The second, third and fourth constraints as felt by the respondent in order of importance were misconception of people that in biogas only cattle dung and urine are used as biogas, food cooked on biogas stove are not consistent with the existing taste of rural women and poor quality manure, respectively.

Table 5.19 Distribution of respondents according to perceived constraints regarding socio-cultural problems in acceptance of biogas

N=100

S.No.	Constraints	Frequency	Percentage	Rank
1.	Habitual to work on traditional method	18	18.00	I
2.	Food items cooked on BG stove are not consistent with the existing taste of rural women	15	15.00	III
3.	Prestige is lowered down in society	4	4.00	VIII
4.	Smokeless atmosphere creates problem of mosquitoes	4	4.00	VIII
5.	During winter season kitchen is not warm because of absence of open fire	8	8.00	VI
6.	No problem with the traditional chulha as we get enough fire wood	13	13.00	V
7.	Unhealthy atmosphere in the house	10	10.00	VI
8.	Poor quality manure	14	14.00	IV
9.	Misconception of people that in biogas only cattle dung and urine is used as biogas	17	17.00	II

Tawde and Ranmare (1990), Chahal and Malaviya (1995) and Kumar Harish (1995) also supported these findings.

The most important constraints perceived as being "habitual to work on traditional method" misconception relating to the biogas plants and inconsistency with the existing taste of cooking seem to be those constraints which need change in accustomed habits and cultural values which are the most difficult core values of any human being and take longest to change. A family composed of different generation in rural households makes it all the more difficult for adopting any new innovation. The field functionaries who are at the grass root level have a very important role in solving the socio-cultural problems as they being one of them can play a pivotal role.

(v) Economic constraints

Table 5.20 shows the distribution of respondents according to economic constraints. Under this, the constraint 'high cost for installation of biogas plant' was considered most important by the maximum number of the respondents and hence ranked first. It was followed by the constraint, 'it's cost of maintenance is more' which was on the second position. The constraints, which were ranked third, fourth, and fifth on the basis of responses obtained, were insufficient bank loan, shortage of sufficient cow dung and disbursement of subsidy and bank loan is not regular, respectively. After this two constraints namely "high cost of iron gas holder and disbursement of subsidy and bank loan is not timely" were on the sixth position.

Similar observations were made by Gowda *et al.* (1981), Dutt (1985), Nagpla *et al.* (1986), Tawde and Ranmare (1990), Chatterjee *et al.* (1991), Digaskar *et al.* (1992), Nimbale and Ansari (1995), Soundarapandian (1992) and Chahal and Malaviya (1995).

Table 5.20 Distribution of respondents according to perceived constraints regarding economic problems in acceptance of biogas

N=100

S.No.	Constraints	Frequency	Percentage	Rank
1.	High cost for installation of biogas plant	25	25.00	I
2.	1 st cost of maintenance is more	18	18.00	II
3.	No direct cash income	3	3.00	VIII
4.	Lack of economic motivation of rural people	-	-	-
5.	Non availability of sufficient water for mixing cow dung regularly	4	4.00	VII
6.	High cost of iron gas holder	5	5.00	VI
7.	Shortage of sufficient cow dung	12	12.00	IV
8.	Insufficient bank loan	16	16.00	III
9.	Replacement of pipeline item increases the cost of maintenance	4	4.00	VII
10.	Disbursement of subsidy and bank loan is not timely	5	5.00	VI
11.	Disbursement of subsidy and bank loan is not regular	8	8.00	V

Installation of biogas plant needs high capital and subsidy and bank loan was not provided sufficiently and timely to the farmers by the leading agencies. Cost of maintenance of the plant also requires substantial amount as the families are not aware of the maintenance, nor have the facilities at affordable price.

(vi) Organizational constraints

Table 5.21 reveals that under organizational constraints majority of the respondents perceived the constraint "inadequate follow up services provide once the technology" has been installed as the most important and hence ranked first. The constraint 'earlier failure of biogas plants in the village due to improper guidance' was ranked second on the basis of responses obtained. The constraints namely non-

availability of trained staffs/masons to construct the biogas plant and non-cooperation by concerned officers were felt as third and fourth according to the respondents.

Table 5.21 Distribution of respondents according to perceived constraints regarding organizational problems in acceptance of biogas

N=100

S.No.	Constraints	Frequency	Percentage	Rank
1.	Earlier failure of biogas plants in the village due to improper guidance	28	28.00	II
2.	Non-cooperation by concerned officers	17	17.00	IV
3.	Non availability of trained staffs/masons to construct the biogas plant	25	25.00	III
4.	Inadequate follow up services provided once the technology has been installed	39	39.00	I

It can be concluded that inadequate follow-up services followed by earlier failure of biogas plants, non-availability and non cooperation of trained staffs and concerned officers were the main important organizational constraints in order of sequence as perceived by respondents.

Kumar (1995) and Kausik and Verma (1994) also supported these findings.

Such trend might be due to the fact that the respondents had seen from their eyes that earlier many biogas plant were failed and become no-functional due to lack of follow up services and other faults on the part of the organizations and concerned offers. The non-availability of technical staffs at reasonable price further contribute to the non-acceptance of biogas.

(vii) Situational constraints

The Table 5.22 depicts that 'lack of space near the house for installation of biogas plants' was most important situational constraint and hence ranked first. The next important constraints were "non cooperative attitude of other institutions existing within the village and difficult to install the biogas plant at a place near to the kitchen as well as animal shed and so ranked second and third, respectively. The constraints namely "Sunlight not available in proper direction and not being portable difficult to use it in various seasons" were ranked fourth and fifth respectively.

Table 5.22 Distribution of respondents according to perceived constraints regarding situational problems in acceptance of biogas

N=100

S.No.	Constraints	Frequency	Percentage	Rank
1.	Not being portable difficult to use it in various seasons	4	4.00	V
2.	Lack of space near the house for installation of biogas plant	41	41.00	I
3.	Non-cooperative attitude of other institution existing within the village	22	22.00	II
4.	It is difficult to install the biogas plant at a place near to the kitchen as well as animal shed	29	29.00	III
5.	Sunlight not available in proper direction	10	10.00	IV

These findings get the support of Jain and Mishra (1978), Johal and Saini (1980), Lehra (1980), Singh (1987), Soundarapandian (1992) and Nimbal and Ansari (1995).

Lack of space was the majority constraint perceived by the respondents. It is a fact that farmers like to cultivate all the land they possess, as such there is more

pressure on land and suitable space is not available for installation of biogas plant near the house.

Overall perceived constraints

Table 5.23 gives the distribution of respondents according to overall perceived constraints. It was found that majority of the respondents (36.00 %) perceived the constraint namely "high cost for installation of biogas plant" as most important and hence, it was ranked first. The constraint "shortage of sufficient cow dung" (31.0 %) ranked second on the basis of responses. Similarly "earlier failure of biogas plants in the village (10.0 %), lack of space near the house for installation of biogas plant (7.0 %) reduced gas supply during winter (6.0 %) were ranked third, fourth and fifth respectively according to the respondents.

It can be concluded that the important constraints perceived by the respondents were economic, organizational, technical, socio-cultural and situational constraints in order of importance.

Jain and Mishra (1978), Johal and Saini (1980), Gowda *et al.* (1981), Pathak (1985), Bhati (1985), Agarwal and Arora (1989), Kumar (1995) and Chahal and Malaviya (1995) also supported the above findings.

The respondents feel that the biogas plant being an expensive innovation is not suitable economically to the average rural family. Shortage of sufficient dung was another major constraint due to low possession of animals which is an important requirement to install biogas plant. The biogas plants already installed in the village have also not been giving good services and the families having biogas plants are also facing lot of problems. As a result of negative views the other families do not seem to be inclined for this technology.

Table 5.23 Distribution of respondents according to overall perceived constraints

N=100

S.No.	Constraints	Frequency	Percentage	Rank
1.	High cost for installation of biogas plant	36	36.00	I
2.	Shortage of sufficient cow dung	31	31.00	II
3.	Earlier failure of biogas plant in the village	10	10.00	III
4.	Lack of space near the house for installation of biogas plant	7	7.00	IV
5.	Reduced gas supply during winter	6	6.00	V
6.	Complication in installation of biogas plant	5	5.00	VI
7.	Food items cooked on biogas stove are not consistent with the existing taste of rural women	4	4.00	VII
8.	Inadequate follow up services provided once the technology has been installed	2	2.00	VIII
9.	Insufficient bank loan	1	1.00	IX
10.	Misconception of people that in biogas only cattle dung and urine is used as biogas	1	1.00	IX

Correlation of crucial factors with constraints

Table 5.24 shows the correlation of crucial factors with constraints in acceptance of biogas technologies.

It can be observed from this table that age was positively and significantly correlated with organizational constraints. Family education was negatively and significantly correlated with operational constraints, socio-cultural constraints

economic constraints, situational constraints and total constraints. It was also found that communication variable and psychological variable were also negatively and significantly correlated with all the perceived constraints namely educational and communicational, technical, operational, socio-cultural, economic, organizational, situational and total constraints.

It means that as age increase, organizational constraint also increases with the increase in family education; there is significant decrease in operational constraints, socio-cultural constraints, economic constraints, situational and total constraints. As the communicational variable and psychological variable increase, all the perceived and results decrease significantly.

Pandya and Vekaria (1992) supported the findings that with the increase in all the psychological characteristics (i.e. attitude economic motivation and scientific orientation, there is decrease in constraint level. Such trend might be due to that older respondents observed the earlier failure of biogas plant in the village due to inadequate follow-up services provided and non-cooperation by concerned officers from a longer time with their experience than the younger ones.

As family educational level increased the family members become more aware of the operational aspects became more scientific and progressive in attitude had more earning capability contributing to better economic position and hence inverse relationship between family education and these constraints were observed.

The communicational and psychological factors play a very important role in perception of the constraint. The effective communication of the technology as well as psychological variable contribute a lot in reducing the perception of constraints which come in the way of biogas technologies.

Table 5.24 Correlation of crucial factors with constraints in acceptance of biogas technologies

S. No	Crucial factors	Educational & communicational constraints	Technical constraints	Operational constraints	Socio-cultural constraints	Economic constraints	Organiza-tional constraints	Situational constraints	Total constraints	
1.	Age	X ₁	0.1161	0.110	0.0267	0.0120	0.1004	0.11297	0.1234	0.1280
2.	Family education	X ₂	-0.1359	-0.1183	-0.2372*	-0.2062*	-0.1125*	-0.0166	-0.1188*	-0.1181*
3.	SES (Socio economic status)	X ₃	-0.0040	0.0115	-0.0465	-0.0381	0.0215	-0.0-113	-0.0182	-0.0111
4.	Farm experience	X ₄	0.0820	0.1195	0.0230	0.0267	0.0206	0.1105	0.0529	0.887
5.	Communicational variable	X ₅	0.5213*	0.4762*	-0.4632*	-0.5453*	-0.5345*	-0.2163*	-0.5347*	-0.5563*
6.	Psychological variable	X ₆	0.4913*	0.4213*	-0.4832*	-0.4812*	-0.4769*	-0.2892*	-0.4681*	-0.5103

1. Relationship of crucial factors and constraints with acceptance of biogas technologies

(i) Biogas stove

Table 5.25 revealed that there was positive and significant correlation of communication variable and psychological variable with the acceptance of biogas stove.

It means that with increase in communication variable scores (information source, mass media exposure and extension contact, and psychological variable scores (innovation proneness, risk orientation and economic motivation) the acceptance of biogas increases significantly.

Table 5.25 Correlation of crucial factors with acceptance of biogas stove

Crucial factors	Correlation coefficient
Age (X_1)	-0.1013
Education (X_2)	0.0211
SES (X_3)	-0.0313
Communicational variable (X_4)	0.4361*
Psychological variable (X_5)	0.4517*

Table 5.25 indicated that with respect to all the constraints there was negative and significant correlation of all the constraints namely educational and communicational, technical, operational, socio-cultural, economic, organizational and total constraints with the acceptance of biogas stove except situational constraint where there was also negative correlation but not significant. It means that there is significant increase in acceptance of biogas stove with a decrease in all the constraints.

Table 5.26 Correlation of constraints with acceptance of biogas stove

Crucial factors	Correlation coefficient
Educational (X_6)	-0.4432*
Technical (X_7)	-0.4648*
Operational (X_8)	-0.5136*
Economic (X_9)	-0.5184*
Situational (X_{10})	-0.0312
Organizational (X_{11})	-0.4816*
Total constraints (X_{12})	-0.4887*

(ii) Manure production

A look at the Table 5.27 makes it clear that there was positive and significant correlation of communicational variable, psychological variable and family education variable, psychological variable and family education with the acceptance of manure production.

Table 5.27 Correlation of crucial factors with acceptance of manure production

Crucial factors	Correlation coefficient
Age (X_1)	-0.0231
Education (X_2)	0.2648
SES (X_3)	-0.0114
Communicational variable (X_4)	0.5483*
Psychological variable (X_5)	0.5603*

It indicates that with increase in communicational variable scores (information source, mass media exposure and extension contact) and psychological variable scores (innovation proneness, risk orientation and economic motivation), the acceptance of manure production increases significantly.

Likewise the increase in family educational status, the acceptance also increases significantly.

Table 5.28 Correlation of constraints with acceptance of manure production

Crucial factors	Correlation coefficient
Educational (X_6)	-0.6345*
Technical (X_7)	-0.5138*
Operational (X_8)	-0.6604*
Economic (X_9)	-0.6415*
Situational (X_{10})	-0.0138
Organizational (X_{11})	-0.6517*
Total constraints (X_{12})	-0.6836*

The Table 5.28 indicated that all the constraints (educational and communicational, technical, operational, socio-cultural, economic, organizational and total constraints) were negatively and significantly correlated with the acceptance of manure production except situational constraint where there was also negative correlation but not significant.

It means that there is significant increase in acceptance of manure production with a decrease in all the constraints.

(iii) Biogas fuel engine

The Table 5.29 clearly depicted that communicational variable and psychological variables were positively and significantly correlated with the acceptance of biogas fuel engine.

Table 5.29 Correlation of crucial factors with acceptance of biogas fuel engine

Crucial factors	Correlation coefficient
Age (X_1)	-0.1103
Education (X_2)	0.0317
SES (X_3)	-0.0214
Communicational variable (X_4)	0.6845*
Psychological variable (X_5)	0.6716*

These findings led to conclude that acceptance of biogas fuel engine increases significantly with increase in communicational variable scores (information source, mass media exposure and extension contact) and psychological variable scores (innovation proneness, risk orientation and economic motivation).

Table 5.30 indicated that all the constraints namely educational and communicational technical, operational, economic, situational, organizational and total constraints were negatively and significantly correlated with acceptance of biogas fuel engine.

Table 5.30 Correlation of constraints with acceptance of biogas fuel engine

Crucial factors	Correlation coefficient
Educational (X_6)	-0.5584*
Technical (X_7)	-0.6134*
Operational (X_8)	-0.7121*
Economic (X_9)	-0.6685*
Situational (X_{10})	-0.4891*
Organizational (X_{11})	-0.5489*
Total constraints (X_{12})	-0.6517*

It means that there is significant increase in acceptance of biogas fuel engine with a decrease in all the constraints.

(iv) Biogas lighting

A perusal of the Table 5.31 makes it clear that communicational variable and psychological variable were positively and significantly correlated with acceptance of biogas lighting.

Table 5.31 Correlation of crucial factors with acceptance of biogas lighting

Crucial factors	Correlation coefficient
Age (X ₁)	-0.1172
Education (X ₂)	0.0181
SES (X ₃)	-0.0162
Communicational variable (X ₄)	0.5353*
Psychological variable (X ₅)	0.4108*

To conclude, as communicational variable scores (information source, mass media exposure and extension contact) and psychological variable scores (innovation proneness, risk orientation and economic motivation) increases, the acceptance of biogas lighting also increases significantly.

Table 5.32 Correlation of constraints with acceptance of biogas lighting

Crucial factors	Correlation coefficient
Educational (X ₆)	-0.6826*
Technical (X ₇)	-0.6634*
Operational (X ₈)	-0.7121*
Economic (X ₉)	-0.6391*
Situational (X ₁₀)	-0.3892*
Organizational (X ₁₁)	-0.7165*
Total constraints (X ₁₂)	-0.7911*

With regard to acceptance of biogas lighting, Table 5.32 clearly pinpointed that all the constraints (educational and communicational, technical, operational

economic, situational, organizational and total constraints) were significantly correlated with its acceptance but in negative direction.

It indicates that acceptance of biogas lighting increases significantly with a decrease in all the constraints.

(v) All technologies combined

Table 5.33 shows the correlation of crucial factors with the acceptance of all technologies combined. It was found that communicational variable psychological variable and family education were positively and significantly correlated with the acceptance of all technologies combined.

It indicates that as communicational variable scores, psychological variable scores and family education increase, the acceptance of all technologies combined also increases significantly.

Singh (1977), Johal (1978) and Singh (1983) also found the positive correlation with respect to communication variables.

Table 5.33 Correlation of crucial factors with acceptance of all technologies combined

Crucial factors	Correlation coefficient
Age (X_1)	-0.0345
Education (X_2)	0.2176*
SES (X_3)	0.0321
Communicational variable (X_4)	0.6816*
Psychological variable (X_5)	0.6858*

Chahal and Malaviya (1995) supported that overall psychological variables was associated with perceived acceptability index of biogas technology.

Grewal and Sohal (1971), Choukidar and George (1972), Singh (1987), Nagpal and Yadav (1991) and Jha (1994) supported the positive and significant correlation with family education.

As scores on communicational variable, psychological variable and family education increase, people become more aware of the advantages and positive aspects of biogas technologies

Table 5.34 Correlation of constraints with acceptance of all technologies combined

Crucial factors	Correlation coefficient
Educational (X_6)	-0.7123*
Technical (X_7)	-0.7714*
Operational (X_8)	-0.7813*
Economic (X_9)	-0.8121*
Situational (X_{10})	-0.3121*
Organizational (X_{11})	-0.7821*
Total constraints (X_{12})	-0.7882*

Table 5.34 shows the correlation between constraints and the acceptance of all technologies combined. It was found that all the constraints namely educational and communicational technical, operational, economic, situational, organizational and total constraints were significantly correlated with the acceptance of all technologies combined but in negative direction.

It means that the acceptance of all technologies combined increases significantly with a decrease in all constraints.

It is supported by the findings of Singh (1977), Johal and Saini (1980), Gowda *et al.* (1981), Rao and Ramana (1984), Dutt (1985), Bhati (1985), Sethi and Choudhary (1985), Nag *et al.* (1986), Tawde and Ranmare (1990), Kute (1993), Chahal and Malaviya (1995) and Kumar (1995). It is evident that these are mainly

the constraints, which are inhibiting the acceptance of biogas technologies by rural households. If these constraints are removed then the acceptance of biogas technologies will automatically increase.

Direct and indirect effect of crucial factors on the acceptance of biogas technologies

(i) Biogas stove

Direct effect

The result of path analysis indicated (Table 5.35) that the highest direct effect on acceptance of biogas stove was exerted by technical constraint (-0.291). This was followed by educational and communicational constraint (-0.211), organizational constraint (0.133) and total constraints (0.128). The least direct effect was exercised by the age of the respondent (-0.002).

Total indirect effect

The variable total constraints exerted highest total indirect effect (-0.482) followed by organizational constraint (-0.460), operational constraint (-0.294), communicational variable (0.221) and economic constraint (-0.217) respectively.

Substantial indirect effect

It was also observed that the variable total constraints exerted highest total indirect effect and also largest substantial indirect effect in negative direction. Therefore, total constraint was also an important variable. The first largest indirect effects were of variables namely total constraints, operational constraint, socio-cultural constraint and organizational constraint in order of sequence. It was also interesting to note that majority of the substantial indirect effect were channelized through technical constraint as all variables were routed through technical constraint. Technical constraint itself was passed through 'educational and communicational

constraint. On the basis of above, it can be confirmed that technical constraint was most important variable affecting directly the acceptance of biogas stove by respondents. It had also provided a way for most of the variables in exerting their substantial indirect effect on acceptance. It was also observed that the variables total constraints exerted highest total indirect effect and also largest substantial indirect effect in negative direction. Therefore, total constraint was also an important variable.

Table 5.35 Path coefficients showing the effect of crucial factors on acceptance of biogas stove

S.No.	Crucial factors	r value	Direct effect	Total indirect effect	Substantial indirect effect
1.	Age X_1	-0.1013	-0.002	-0.111	-0.013 X_8 -0.015 X_7 0.016 X_{13}
2.	Family education X_2	0.0211	-0.051	0.101	0.028 X_8 0.017 X_7 0.028 X_{13}
3.	SES X_3	-0.0313	-0.017	-0.011	-0.019 X_2 -0.014 X_8 0.010 X_5
4.	Communicational variable X_4	0.4361*	0.101	0.221	0.204 X_8 0.210 X_7 -0.119 X_{13}
5.	Psychological variable X_5	0.4517*	0.016	0.296	0.211 X_8 0.119 X_7 -0.116 X_{13}
6.	Constraints educational and communicational constraints X_6	-0.4432*	-0.211	-0.203	-0.234 X_8 0.116 X_{12} 0.116 X_{13}

7.	Technical constraints	X_7	-0.4648*	-0.291	-0.217	-0.210 X_7 0.126 X_{12} 0.123 X_{13}
8.	Operational constraints	X_8	-0.5136*	-0.021	-0.294	-0.243 X_8 -0.112 X_7 0.116 X_{13}
9.	Socio-cultural constraints	X_9	-0.5123*	-0.132	-0.313	-0.0142 X_8 -0.155 X_7 -0.182 X_{13}
10.	Economic constraints	X_{10}	-0.5184*	-0.111	-0.217	-0.129 X_8 -0.149 X_7 0.101 X_{13}
11.	Situational constraints	X_{11}	-0.0312	0.016	-0.122	0.019 X_7 0.016 X_{14} -0.014 X_8
12.	Organizational constraints	X_{12}	-0.4816*	0.133	-0.460	-0.239 X_8 -0.158 X_7 -0.110 X_{13}
13.	Total constraints	X_{13}	-0.4887*	0.128	-0.482	-0.261 X_8 -0.165 X_7 0.186 X_{13}

On the basis of above, it can be confirmed that technical constraint was most important variable affecting directly the acceptance of biogas stove by respondents.

(ii) Manure production

Direct effect

A look at the Table 5.36 makes it clear that the highest influence on acceptance of manure production was exerted by 'organizational constraint' (-0.298) followed by technical constraint (-0.181) total constraints (0.150) and economic constraint (-0.134), respectively.

Total indirect effect

The variable total constraints had exerted highest negative total indirect effect (-0.813) followed by socio-cultural constraint (-0.4361) operational constraint educational and communicational constraint (-0.328) and economic constraint (-0.309), respectively in negative direction.

Table 5.36 Path coefficients showing the effect of crucial factors on acceptance of manure production

S.No.	Crucial factors	r value	Direct effect	Total indirect effect	Substantial indirect effect
1.	Age X_1	-0.0231	0.020	-0.028	-0.019 X_{12} -0.015 X_8 -0.016 X_{13}
2.	Family education X_2	0.2648	0.022	0.117	0.025 X_{13} 0.035 X_{11} -0.029 X_{12}
3.	SES X_3	-0.0114	-0.018	0.018	0.012 X_1 -0.010 X_6 0.011 X_2
4.	Communicational variable X_4	0.5483*	0.018	0.130	0.232 X_{13} 0.119 X_8 -0.114 X_{12}
5.	Psychological variable X_5	0.5603*	0.105	0.123	0.206 X_{13} 0.103 X_{12} -0.103 X_8
6.	Constraints educational and communicational constraints X_6	-0.6345*	0.111	-0.328	-0.265 X_{13} -0.140 X_8 0.135 X_{12}
7.	Technical constraints X_7	-0.5138*	-0.181	-0.344	-0.246 X_{13} 0.131 X_{12} -0.118 X_{11}

8.	Operational constraints	X_8	-0.6604*	0.010	-0.358	-0.245 X_{13} -0.147 X_8 0.129 X_{12}
9.	Socio-cultural constraints	X_9	-0.4361	0.117	-0.223	-0.178 X_{13} -0.146 X_8 0.141 X_{13}
10.	Economic constraints	X_{10}	-0.6415*	-0.134	-0.309	-0.270 X_{12} 0.141 X_{13} -0.137 X_8
11.	Situational constraints	X_{11}	-0.0138	0.017	-0.119	-0.014 X_{12} 0.015 X_{13} -0.019 X_6
12.	Organizational constraints	X_{12}	-0.6517*	-0.298	-0.261	-0.144 X_8 0.141 X_{13} -0.118 X_{11}
13.	Total constraints	X_{13}	-0.6836*	0.150	-0.813	-0.284 X_{13} -0.159 X_8 0.126 X_{11}

Substantial indirect effect

The first largest indirect effects were of variables like total constraints, socio-cultural, economic and educational and communicational constraints in order of sequence. It was also exciting to note that majority of the substantial effects were channelized through organizational constraint. Organizational constraint itself was passed through technical constraint.

It is very clear that organizational constraint was the most important variable affecting directly the acceptance of manure production. It had also provide a way for most of the variables in exerting their substantial indirect effect on the acceptance. It was also observed that total constraints and socio-cultural constraint

had exerted highest and second highest total indirect effect and also largest and substantial indirect effect on acceptance. Therefore, total constraints and socio-cultural constraints were also important variables affecting indirectly the acceptance of manure production. The study had also shows a negative and significant relationship of organizational, technical, socio-cultural and total constraints with the acceptance of manure production.

(iii) Biogas fuel engine

Direct effect

The data in Table 5.37 pinpointed that the variable total constraints had the highest direct effect (-0.438) on acceptance of biogas fuel engine in negative direction followed by organizational constraint (0.217) and communicational variable (0.104) in negative and positive directions, respectively.

Table 5.37 Path coefficients showing the effect of crucial factors on acceptance of biogas fuel engine

S.No.	Crucial factors	r value	Direct effect	Total indirect effect	Substantial indirect effect
1.	Age X_1	0.1103	0.119	-0.126	-0.110 X_{12} -0.016 X_4 -0.018 X_{13}
2.	Family education X_2	0.0317	-0.011	0.122	0.116 X_{12} 0.023 X_{13} 0.027 X_5
3.	SES X_3	-0.0214	0.012	0.010	0.015 X_1 0.011 X_5 -0.011 X_2
4.	Communicational variable X_4	0.6845*	0.104	0.231	0.304 X_{12} 0.119 X_{13} -0.100 X_8

5.	Psychological variable	X_5	0.6716*	-0.121	0.346	$0.359 X_{12}$ $0.114 X_{13}$ $-0.129 X_5$
6.	Constraints educational and communicational constraints	X_6	-0.5584*	0.028	0.425	$-0.482 X_{12}$ $-0.108 X_{13}$ $-0.117 X_5$
7.	Technical constraints	X_7	0.6134*	0.121	-0.452	$-0.466 X_{12}$ $-0.117 X_{13}$ $-0.119 X_5$
8.	Operational constraints	X_8	0.7121*	0.023	-0.376	$-0.459 X_{12}$ $-0.116 X_{13}$ $-0.118 X_5$
9.	Socio-cultural constraints	X_9	-0.575*	0.014	-0.268	$-0.205 X_{12}$ $-0.115 X_{13}$ $-0.119 X_5$
10.	Economic constraints	X_{10}	-0.6685*	0.031	-0.411	$-0.304 X_{12}$ $-0.110 X_{13}$ $-0.119 X_5$
11.	Situational constraints	X_{11}	-0.4891*	-0.016	-0.131	$-0.181 X_{12}$ $0.048 X_{13}$ $0.047 X_5$
12.	Organizational constraints	X_{12}	-0.5489*	-0.217	-0.361	$-0.603 X_{12}$ $-0.119 X_5$ $0.111 X_8$
13.	Total constraints	X_{13}	-0.6517*	-0.438	0.110	$-0.118 X_{13}$ $-0.115 X_5$ $0.111 X_8$

Total indirect effect

The variable technical constraint had the highest (0.452) total indirect effect in negative direction followed by educational and communicational constraint (-0.425), economic constraint (-0.411), respectively and operational constraint (-0.376) respectively.

Substantial indirect effect

It was observed that the first largest indirect influence was exercised by socio-cultural constraint economic constraint, organizational constraint and educational and communicational constraints in order of sequence. The variables like organizational constraint and total constraints were important as substantial indirect effect of as many as twelve (12) attributes were routed through each of these two variables.

It was also found that communicational variable had third highest positive direct effect on acceptance while educational and communicational constraint had third highest total indirect effect on acceptance of biogas fuel engine. It was also clear that organizational constraint, socio-cultural constraint, educational and communicational constraint and total constraints were negatively and significantly correlated with acceptance of biogas fuel engine.

(iv) Biogas lighting

Direct effect

The results (Table 5.38) revealed that the attributed "total constraints" exerted highest direct effect on the acceptance of "biogas lighting" the path coefficient being 0.475. This was followed by economic constraint (-0.394), organizational constraint (-0.206) and technical constraint (-0.97) respectively. The

least direct effect was exerted by socio-economic status (0.006) of the respondent on acceptance of biogas lighting.

Total indirect effect

The variable 'total constraints' had the highest total indirect effect (-0.804) on acceptance followed by socio-cultural constraint psychological variable (0.394), communicational variable (0.332) and operational constraint (-0.281), respectively.

Table 5.38 Path coefficients showing the effect of crucial factors on acceptance of biogas lighting

S.No.	Crucial factors		r value	Direct effect	Total indirect effect	Substantial indirect effect
1.	Age	X_1	-0.1172	0.019	-0.127	$0.112 X_{13}$ $-0.019 X_{11}$ $0.010 X_{13}$
2.	Family education	X_2	0.0181	-0.115	0.123	$-0.113 X_{14}$ $0.107 X_{11}$ $0.027 X_{13}$
3.	SES	X_3	-0.0162	0.001	-0.013	$-0.026 X_2$ $-0.011 X_{13}$ $-0.013 X_8$
4.	Communicational variable	X_4	0.5353*	0.101	0.332	$-0.350 X_{13}$ $0.295 X_{11}$ $-0.239 X_{13}$
5.	Psychological variable	X_5	0.4108*	-0.013	0.394	$-0.309 X_{12}$ $0.263 X_{11}$ $-0.212 X_{13}$
6.	Constraints educational and communicational constraints	X_6	-0.6826*	-0.166	-0.288	$0.423 X_{12}$ $-0.327 X_{11}$ $-0.272 X_{13}$

7.	Technical constraints	X_7	-0.6634*	-0.197	0.251	0.409 X_{12} -0.301 X_{11} -0.253 X_{13}
8.	Operational constraints	X_8	-0.7121*	-0.118	-0.281	0.402 X_{12} -0.311 X_{11} -0.252 X_{13}
9.	Socio-cultural constraints	X_9	-0.4941*	-0.026	-0.345	0.145 X_{12} -0.155 X_{11} -0.183 X_{13}
10.	Economic constraints	X_{10}	-0.6685*	-0.394	-0.123	0.444 X_{12} -0.278 X_{13} -0.150 X_8
11.	Situational constraints	X_{11}	0.4891*	-0.101	-0.100	0.162 X_{12} -0.116 X_{11} -0.016 X_{13}
12.	Organizational constraints	X_{12}	-0.5489*	-0.206	-0.209	0.4432 X_{12} -0.353 X_{11} 0.158 X_8
13.	Total constraints	X_{13}	-0.6517*	0.475	-0.804	-0.373 X_{11} -0.291 X_{13} -0.174 X_8

Substantial indirect effect

The first largest indirect effect was exercised by economic constraint, organizational constraint and educational and communicational constraint in order of sequence. It was also interesting to note that majority of the substantial indirect effects were channelized through 'total' constraints and economic constraint, respectively.

It can be observed that the variable total constraints was the most important variable effecting directly and indirectly the acceptance of biogas lighting. The variable 'economic constraint and organizational constraint' were also very important since they had second and third highest direct effect and substantial indirect effect on acceptance. Two variables namely total constraints and economic constraint had also provided a way for most of the variables in exerting their substantial indirect effect on acceptance. It was also found that the variable socio-cultural constraint had exerted the largest substantial indirect effect and second highest total indirect effect on acceptance in negative direction.

As previously mentioned, these four constraints i.e., economic, socio-cultural, organizational and total constraints had negative and significant correlation with the acceptance of biogas lighting.

(v) All technologies combined

Direct effect

A look at the Table 5.39 makes it clear that the highest direct effect was exerted by 'total constraints (0.358) followed by organizational constraint (0.220) economic constraint (-0.206) and educational and communicational constraint (-0.197), respectively. The least direct effect was exerted by technical constraint.

Total indirect effect

The variable 'total constraints' had exerted the highest total indirect effects (-0.981) followed by technical constraint (-0.406) psychological variable (0.364), communicational variable (0.344) and socio-cultural constraint (-0.512) respectively.

Table 5.39 Path coefficients showing the effect of crucial factors on acceptance of all technologies combined

S.No.	Crucial factors	r value	Direct effect	Total indirect effect	Substantial indirect effect
1.	Age X_1	-0.0345	-0.017	-0.018	0.101 X_{12} -0.012 X_{13} 0.011 X_4
2.	Family education X_2	0.2176*	-0.012	0.117	-0.119 X_{12} 0.0119 X_{13} 0.014 X_{11}
3.	SES X_3	0.0321	0.019	0.017	0.022 X_{11} 0.017 X_1 -0.016 X_{13}
4.	Communicational variable X_4	0.6816*	0.110	0.344	-0.343 X_{12} 0.252 X_{13} 0.239 X_{11}
5.	Psychological variable X_5	0.6858*	0.011	0.364	-0.308 X_{12} 0.224 X_{13} 0.217 X_{11}
6.	Constraints educational and communicational constraints X_6	-0.7123*	-0.197	-0.310	0.306 X_{12} -0.286 X_{13} -0.261 X_{11}
7.	Technical constraints X_7	-0.7714*	-0.011	-0.406	0.393 X_{12} -0.266 X_{13} -0.242 X_{11}
8.	Operational constraints X_8	-0.7813*	-0.150	-0.321	0.387 X_{12} -0.265 X_{13} -0.249 X_{11}
9.	Socio-cultural constraints X_9	-0.413*	0-103	-0.512	0.524 X_{12} -0.199 X_{13} -0.179 X_{11}

10.	Economic constraints	X_{10}	-0.8121*	-0.206	-0.528	$0.423 X_{12}$ $-0.293 X_{13}$ $-0.164 X_7$
11.	Situational constraints	X_{11}	-0.3121*	-0.010	-0.171	$0.125 X_{12}$ $0.019 X_{11}$ $-0.019 X_{13}$
12.	Organizational constraints	X_{12}	0.7821*	-0.220	-0.521	$0.423 X_{13}$ $-0.271 X_{11}$ $-0.172 X_7$
13.	Total constraints	X_{13}	-0.7882*	0.358	-0.981	$-0.207 X_{13}$ $-0.202 X_{11}$ $0.179 X_7$

Substantial indirect effect

The substantial indirect effect of crucial factors indicated that the first largest indirect effect was exercised by economic constraint, organizational constraint and educational and communicational constraint in order of sequence. It was also interesting to note that majority of the substantial effects were channelized through total constraints.

So, all these results have clearly established that the variable 'total constraints' was most important variable affecting directly and indirectly the acceptance of all Biogas technologies combined. It had also provide a way for most of the variables in exerting their indirect substantial effects on the acceptance of all technologies combined. It was also observed that the largest indirect substantial effect on acceptance of all technologies combined was exercised by socio-cultural constraint. It was also remarkable that organizational constraints and economic constraint were also important as they had second and third highest direct effect and

substantial indirect effect. The variables total constraints, socio cultural constraint, organizational constraint and economic constraint had negative and significant correlation with the acceptance of all technologies combined.

To conclude the result of path analysis clearly established that –

1. Acceptance of biogas stove increased as technical, educational and communicational and total constraints decreased.
2. Acceptance of manure production increased as organizational technical and total constraints decreased.
3. Acceptance of biogas fuel engine increased as organizational, educational and communicational and total constraints decreased.
4. Acceptance of biogas lighting increased as economic organizational and total constraints decreased.
5. Acceptance of all technologies combined increased as total constraints, socio-cultural constraint, organizational constraint and economic constraint decreased.

Similar findings were reported by Pathak (1985), Agarwal and Arora (1989), Tawde and Ranmare (1990), Soundarapandian (1992), Kaushik and Verma (1994), Chahal and Malaviya (1995) and Kumar (1995).

It can be seen that these are the constraints (organizational, socio-cultural, economic, technical, educational and communicational and total constraints, which are mainly influencing the acceptance of biogas technologies both individually and collectively. Whether by correlation analysis or by path analysis, we arrive at the same result that the constraints are inhibiting directly as well as indirectly the acceptance of biogas technologies. Although contributory factors are there like communicational variable, psychological variable and family education which are

affecting acceptance positively, but, the effect of these contributory factors are suppressed by all the constraints.

The govt. and agencies concerned with energy, must observe this point. In place of increasing the coverage, they should provide facilities for quick repairing of old, and sick plants already installed earlier so that these can create positive impact on the attitude of surrounding inhabitants and act as a source of motivation for others to accept and adopt the biogas technologies.

Efforts must be taken to remove socio-cultural constraint by changing the already existing cultural values and attitude of people. Similarly, technical educational and communicational economic and total constraints must be taken care of by the government, because these are responsible for low acceptance of biogas technologies. Unless the solution to these problems is given the propagation of biogas technologies will have serious set back. Therefore, remedial measures should be taken by the agencies immediately to remove these constraints. A large number of failures will discourage people from adopting new technology and will create an atmosphere of disappointment and pessimistic outlook, the govt. should give priority to biogas plant on a war-footing to solve the problem of energy in rural areas.

Summary and Conclusion



Chapter-V

SUMMARY, CONCLUSION AND SUGGESTIONS

Energy is the most fundamental requirement in every sphere of life. It is the most important component for economic development of a country and for improving the quality of life of the people. With the advancement in Science and Technology and industrial development, the need of energy has increased manifold all over the world. This is more so in developing countries like India. Energy crisis has reached a critical stage in rural India, for the simple reason that the conventional energy reserves are finite. Coal, oil, wood and kerosene are becoming scarce and expensive day by day. As a consequence, poor people of rural India are most affected.

The problems of population explosion, environmental degradation and fast depleting reserves of fossil fuels have necessitated to think about non-conventional sources of energy.

The Government has been making tremendous efforts in this direction. The development and utilization of new and renewable sources of energy opens up the prospect of increasing indigenous energy supply and thereby contributing to greater self-sufficiency. Non-conventional energy is eminently suited meeting the basic energy needs of rural households. Traditionally, rural households have been dependent upon biomass fuels. Greater responsibility for women and children in gathering these fuels, low efficiency of usage, deforestation, increase drudgery and its adverse impact on the health of the women are the unfortunate features of the scenario.

Hence, the non-commercial energy like biogas seems to be the ultimate reserved answer to the energy crisis at present. Being predominantly a rural

country and containing large cattle population and an agricultural base this country has sizable biogas potential which can be harnessed to meet the energy needs especially of rural areas.

Various governmental and non-governmental organizations have made their efforts to popularize biogas technology for solving the problem of fuel as well as manure. In spite of these efforts biogas technology is not successful to the desired extent. Despite the bright prospects, the response of the people so far have been poor. Non-adoption of biogas plant may be due to various constraints which may be further aggravated due to the individual's attitude towards acceptance of biogas technology, individual's knowledge of the technology and various other socio-personal economic, communicational and psychological factors.

With these ends in view, the study was designed with the following specific objectives.

1. To study the socio-economic profile of the respondents and households.
2. To assess the perception of rural families about applicability of not conventional energy sources.
3. To assess the attitude of rural families in acceptance of non-conventional energy devices.
4. To identify the constraints in acceptance of non-conventional energy devices by rural families.
5. To suggest the suitable measures for removal of constraints faced by rural families in acceptance of non-conventional energy devices.

RESEARCH METHODOLOGY

The study was conducted in U.P. state. U.P. state has been divided in four zones, Western, Central, Eastern and Bundelkhand. Fatehpur district of eastern zone was purposively selected for the present study. Two blocks from Fatehpur district, i.e. Haswa and Teliyani was selected randomly. Out of two blocks, twelve villages were selected randomly. For the collection of data 200 households were selected from the selected villages. The data were selected with the help of structural interview schedule. There are two type of variables viz., dependent and independent were studied, the socio-economic variable taken were just accordance with Trivedi's socio-economic scale. They are age, education, caste, religion, occupation, marital status, type of family, source of income and social participation etc. These variables were empirically defined and measured with the help of instruments either already available or developed by the researcher.

The statistical techniques applied for analyzing the data were percentage, arithmetic average, correlation, standard deviation (S.D.), attitudinal gain, knowledge, weighted score etc.

I. Profile of the respondents

1. Almost similar percentage (57.50 %) of the respondents belonged to 36-50 years of age and 33.0 per cent of age group (20-35 years).
2. Majority of the respondents (about 21.0 %) had middle level of education.
3. Half of the respondent's families (37.5 %) were engaged in agricultural labour as their main occupation.
4. 38.0 per cent respondents belonged to OBC caste. Almost equal percentage of respondents belonged to middle and higher caste.

5. 56.0 per cent of the respondents belonged to low income group (Rs. 2000-4000).
6. About 49.0 per cent respondents had land up to one acre followed by 21.0 per cent having land up to 3 acres.
7. Slightly more than half (61.0 %) of the respondents belonged to nuclear family type.
8. About 44.0 per cent of the respondents had up to 2 animals.
9. Majority (70.0 %) of the respondents were members of one organization.
10. Majority of the respondents (63.0 %) had low level of material possession.
11. Majority of the respondents (45.5 %) had medium level of communicational variable scores.
12. Majority of the respondents (43.0 %) had low level of psychological variable scores followed by almost equal percentage of respondents having medium (37.0 %) and low (33.33%) level.

II. Awareness of NCED

With regard to awareness of NCED, it was found that majority (92.0 %) of the respondents were aware of biogas, followed by 35.0, 12.5 and 16.0 per cent respondents who were aware of smokeless chulha, solar lantern and solar cooker, respectively. While only 4.00, 2.00 and 1.00 per cent respondents were aware of wind mill, solar water heater and solar photovoltaic system respectively.

III. Possession of NCED

It was found that 18.00 per cent respondents possessed biogas followed by 5.00 per cent respondents who possessed smokeless chulha while only 2.00 per cent respondents were having solar lantern.

IV. Perception of applicability of NCEDs

- (i) Biogas was applicable more in homestead activities as compared to farmstead activities.
- (ii) Among the homestead activities, the applicability of biogas was higher for different cooking operations than lighting and flour milling.
- (iii) Among the cooking operations, majority of the respondents perceived biogas as fully applicable for water heating, boiling milk, making tea, cooking kheer, preparing halwa, preparing pakora, roasting groundnut and roasting spice while it was partially applicable for preparing vegetable, cooking rice, preparing dal and preparing chapati.
- (iv) More than 80.0 per cent respondents perceived that biogas was partially applicable for lighting.
- (v) 90.0 per cent respondents were not aware of flour milling application of biogas.
- (vi) Among the farm activities, more than half of the respondents perceived biogas as partially applicable for 'manure production'. While 90.0 per cent of the respondents were not aware of its applications in rest of the farmstead activities namely pumping, ploughing and chaff-cutting.

2. Smokeless chulha

- (i) Smokeless chulha was applicable only for cooking operations under homestead activities.
- (ii) More than half of the respondents (55.0 %) were not aware of applicability of smokeless chulha.
- (iii) Among these who were aware more than 25.0 per cent respondents perceived it as fully applicable for water heating, boiling milk making tea and cooking kheer while partially applicable for cooking rice, preparing dal and preparing vegetables.

3. Solar cooker

- (i) Solar cooker was used exclusively for cooking purpose under homestead activities.
- (ii) More than three fourth of the respondents (70.0 %) were not aware of applicability of solar cooker.
- (iii) Among those who were aware, majority of respondents perceived that it was partially applicable for preparing dal and cooking rice.

4. Solar photovoltaic system (SPV system)

- (i) More than 95.0 per cent of the respondents were not aware of applicability of SPV system for household lighting.
- (ii) Under farmstead activity, none of the respondents was aware of applicability of SPV system for pumping.

5. Wind mill

- (i) More than 90.0 per cent of the respondents were not aware of applicability of wind mill.

- (ii) Almost all the respondents who were aware perceived it as not at all applicable for flour milling and pumping.

6. Solar lantern

- (i) More than 93.0 per cent of the respondents were not aware of the applicability of solar lantern for household lighting.
- (ii) Majority of respondents who were aware perceived solar lantern as partially applicable.

7. Solar water heater

- (i) Majority of the respondents (95.0 %) were not aware of applicability of solar water heater.

V. Present traditional devices used (activity wise)

1. Under homestead activities, majority of the respondents used firewood chulha (90.0 %) followed by dung cake chulha (56.0 %). For cooking, kerosene oil lantern (30.0 %) for light and diesel mill (96.33 %) for flour milling.
2. Under farm stead activities, majority of the respondents used natural devices (rain water) followed by diesel pumpset for pumping, animal driven (99.0 %) followed by manual chaff cutter (95.0 %) for chaff cutting and compost (100.0 %) chemical fertilizer (7.0 %) for manure production.

1. Differential attitude towards acceptance of biogas technologies

- (i) In case of all the four technologies, before exposing media package on biogas technologies, majority of the respondents ranging (94.0 %) were having not all favourable attitude followed by respondents having 'some what favourable' attitude and none of the

respondents was having favourable or highly favourable attitude towards acceptance.

- (ii) After media package exposure on biogas technology in case of all the four technologies, majority of respondents ranging (64.0 – 72.0 %) were having 'some what favourable' attitude and none of the respondents was found to have 'not at all favourable' attitude towards acceptance of biogas technologies.
- (iii) In case of biogas stove, half of the respondents (60.0 %) had low attitudinal gain followed by 30.0 per cent respondents having medium level of attitudinal gain while 10.0 per cent respondents had high level of attitudinal gain.
- (iv) In case of manure production, more than half of the respondents (50.0 %) had attitudinal gain of low level followed by 30.0 per cent respondents having medium level of attitudinal gain, while 8.0 per cent respondents had high level of attitudinal gain.
- (v) In case of biogas fuel engine 69.0 per cent respondents had low level of attitudinal gain followed by 27.0 per cent respondents having medium level of attitudinal gain and only 4.0 per cent respondents had high level of attitudinal gain.
- (vi) In case of biogas lighting 70.0 per cent respondents had low level of attitudinal gain followed by 27.0 per cent respondents having medium level of attitudinal gain while only 3.0 per cent respondents had high level of attitudinal gain.

II. Knowledge level of biogas technologies

- (i) Before exposing media package on biogas technologies to the respondents, in case of all the four technologies, all the

respondents (100.0 %) obtained almost negligible knowledge scores which was less than overall mean.

- (ii) All the post-exposure stage 29.0, 52.0, 36.0 and 50.0 per cent respondents obtained knowledge scores greater than overall mean in case of biogas stove, manure production, biogas fuel engine and biogas lighting, respectively.

Rest of the respondents obtained scores less than overall mean. In case of all these four technologies.

- (iii) With regard to the overall knowledge scores, it was found that at exposure stage, more than half of the respondents (51.0 %) obtained scores greater than overall mean and rest of the respondents obtained scores less than overall mean.

III. Acceptance of biogas technologies

- (i) Majority of the respondents i.e. 48.0, 56.0, 55.0, 59.0 per cent respondents had low level of acceptance of biogas and stove, manure production, biogas fuel engine and biogas lighting, respectively.
- (ii) With regard to acceptance of all technologies combined, it was found that only one-fourth of the respondents (23.0 %) had high level of acceptance. Majority of the respondents (49.0 %) had low level of acceptance.

I. Perceived constraints in acceptance of biogas technologies

Organizational constraint was perceived by majority of the respondents as obtained scores more than overall mean. It was followed by situational, technical, economic, educational and communicational and socio-cultural

constraints, respectively. While 'operational constraint' was perceived by minimum number of respondents.

II. Ranking within the categories

- (i) Under educational and communicational constraint, the most commonly felt constraint was lack of effective communication between the field functionaries and rural women and so ranked first which was followed by 'inadequate information given by technical staffs regarding biogas plant on second position.
- (ii) Under technical constraints, the most important perceived constraint was 'complication in installation of gas plant' on the first position.
- (iii) Under operational constraints, the first most important constraint perceived by the respondents was repairing facility is not available in the village.
- (iv) Under socio-cultural constraint, the first most important constraint perceived by the respondent was 'habitual to work on traditional method. The second and third constraints as felt by the respondents in order of importance were misconception of people that in biogas only cattle dung and urine are used as biogas and foods cooked on biogas stove are not consistent with the existing taste of rural women, respectively.
- (v) Under economic constraints, the most important perceived constraint was high cost for installation of biogas plant. According to the respondents and hence ranked first.

- (vi) Under organizational constraints, the first most important constraint perceived by the respondents was inadequate follow up services, provided once the technology has been installed.
- (vii) Under situational constraints, lack of space near the house for installation of biogas plants was most important constraint and hence ranked first.

IV. Correlation of crucial factors with constraint

- (i) Age was positively and significantly correlated with organizational constraints.
- (ii) Family education was negatively and significantly correlated with operational constraints, socio-cultural constraints, economic constraints, situational constraints and total constraints.
- (iii) Communicational variable and psychological variable were also negatively and significantly correlated with all the perceived constraints namely educational and communicational, technical, operational, socio-cultural, economic organizational, situational and constraints.

I. Relationship of crucial factors and constraints with acceptance of biogas technologies

- (i) There was positive and significant correlation of communication variable and psychological variable with the acceptance of biogas stove.
- (ii) With respect to all the constraints, there was negative and significant correlation of all the constraints namely educational and communicational, technical, operational, socio-cultural, economic, organizational and total constraints with the acceptance of biogas


stove except situational constraints where there was also negative correlation but not significant.

- (iii) All the constraints were negatively and significantly correlated with the acceptance of manure production except situational constraints, where there was also negative correlation but not significant.
- (iv) Communication variable and psychological variable were positively and significantly correlated with the acceptance of biogas fuel engine.
- (v) Communication variable and psychological variable were positively and significantly correlated with acceptance of biogas lighting.
- (vi) Communication variable psychological variable and family education were positively and significantly correlated with the acceptance of all technologies combined.
- (vii) All the constraints namely educational and communicational technical, operational, socio-cultural , economical situational, organizational and total constraints were negatively and significantly correlated with the acceptance of all technologies combined.

II. Direct and indirect effect of crucial factors on the acceptance of biogas technologies

- (i) Acceptance of biogas stove increased as technical, educational and communicational and total constraints decreased.
- (ii) Acceptance of manure production increased as organizational, technical, socio-cultural and total constraints decreased.

Suggestions and Policy Implication



- (iii) Acceptance of biogas fuel engine increased as organizational, socio-cultural, educational and communicational and total constraints decreased.
- (iv) Acceptance of biogas lighting increased as economic, socio-cultural, organizational and total constraints decreased.
- (v) Acceptance of all technologies combined increased as total, socio-cultural, organizational and economic constraints decreased.

Suggestions, recommendations and policy implications

1. In order to promote awareness about NCEDs, an effective educational programme needs to be organized by extension workers and field functionaries. In this programme village Panchayat, ICDS functionaries and college of home science can play an important role
2. The government and other agencies need to launch a massive multi-media information campaign to create awareness of NCEDs.
3. Rural women are still using traditional devices, local leaders, women functional leaders if get biogas plant in their houses can serve as a strong motivating factor for the rest of community.
4. Government, extension agencies and voluntary agencies can give, frequent exposure so actual demonstration and educational programmes with the help of video films, reinforced by small booklets or leaflets on biogas technologies for increasing the knowledge of rural women.
5. A maintenance and regular repair workshop run by the village Panchayat can ensure that rural women about the problems of maintenance and technical difficulties.

6. Installation of biogas plant is expensive. The rural families can have the facility of getting loan and also subsidy from the government agencies. The government agencies can ensure simple procedure for getting the loan, timely on a regular basis and rate of interest also to be reduced so that maximum number of rural families can take the benefit.
7. An intensive and extensive educational programme needs to be organized for the rural women by the field functionaries to overcome the psychological towards using biogas as a fuel for cooking.
8. Present need is to change the attitude of rural women and they should be motivated against the use of firewood, cow dung, cakes as fuel.
9. Engineering colleges can play a very important role in overcoming the technical problems of the biogas plant if a regular programme incorporating regular field visit to the families having biogas plants become a part of the field practicals of their students.
10. A small guidance cell on biogas technology organized in the village can help the rural families from time to time as and when they require guidance and help on biogas technologies.
11. Training is one of the most important inputs for success of biogas technology. So far training has been given only to home scientist and staff of the government departments. It is observed that the beneficiaries have no training on the mechanism of biogas technology at all, so they are not able to maintain the gas plant

properly. This ultimately results in defunct plants and that curbs the interest of the people who are willing to adopt the gas plant.

12. The extension personnel in the Department of Agriculture, specialist of agricultural universities and concerned agencies should intensively involve themselves in rendering technical guidance to the farm families for acceleration and sustainability of acceptance of biogas plants.
13. Many a time shortage of materials, especially cement delays installation. An arrangement should be made for supply of cement on priority basis for the biogas plants.
14. The government programme is focused on installation of biogas plants rather than on sustainable use by the rural households. An effective action plan by different agencies involved in installation needs to intensify their composite package including educational, maintenance, follow up and input available.
15. Suitable extension mechanism has to be developed for creating awareness, motivation, front line technical and financial support in installation operation and maintenance of biogas plant.
16.
 - (a) Central subsidy to users.
 - (b) Remuneration to SEWs
 - (c) Dealership support to fair price shops (FPS) and Public Distribution System (PDS) outlets.
 - (d) Organizational and infrastructure support to implementing agencies.
 - (e) Publicity support

- (f) Technical back-up units (TBUs) functioning in 13 states technical and training support for effective implementation.

17. Investment opportunities exist in :

- Manufacture of biogas burners
- Manufacture of high quality biogas lamps
- Production of dual-fuel and biogas engines.

18. Incentives for biogas

- Special incentives are available for turnkey entrepreneurs in rural areas to carry out biogas
- Besides dedicated nodal department and nodal agencies central agencies such as the Khadi and Village Industries Commission (KVIC) also promote NPBD, National and Regional level NGOs are also involved.
- Commercial and cooperative banks provide loans for setting up of biogas plants under agricultural priority area.
- NABARD is providing the facility of automatic refinancing to banks.
- Turn key job free is given to entrepreneurs, service charges is provided to SNPs/SNAs for training and publicity are also supported.
- There are biogas development and training centres functioning in nine major states, to provide technical and training back up to SNDs and SNAs. Investment opportunities in energy efficient wood burning cook stoves : manufacture of portable metallic chulhas.

- Manufacture of various chulha components.
- Maintenance and services
- Training.

19. Policies and incentives

- Central subsidy to users
 - Remuneration to SEWs
 - Dealership Support to Fair Price Shops (FPS) and Public Distribution System (PDS) outlets.
 - Organizational and infrastructure support to implementing agencies.
 - Publicity support
 - Technical backup units (TBUs) functioning in 13 states provide technical and training support for effective implementation.
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Appendices

Spec. of family

Family size

Family size

Family size

QUESTIONNAIRE

A STUDY ON ACCEPTANCE AND CONSTRAINTS OF NON-CONVENTIONAL ENERGY DEVICES USED BY RURAL HOUSEHOLD.

(A) General profile of the respondents

Name of the respondent

Age

Occupation

- (i) No work
- (ii) Agril. labourer
- (iii) Caste occupation
- (iv) Small scale industry
- (v) Independent profession
- (vi) Construction work
- (vii) Business
- (viii) Service
- (ix) Any other work
- (x) Farming

Caste

- (i) Upper
- (ii) Middle
- (iii) Lower

Average monthly income

Land holding

(a) No land

(b) Up to 1 ha

(c) 1 to 2 ha

(d) 2 ha and above

Type of family

(a) Nuclear

(b) Joint

Family size

(a) Up to 3 members

(b) 3 to 5 members

(c) Above 5 members

No. of milch animal

- (a) No animal
- (b) Up to 2 animals
- (c) 2 – 3 animals
- (d) More than 3 animals

Education of respondent

- (a) Illiterate
- (b) Can read only
- (e) Primary
- (f) Middle
- (g) High school
- (h) Graduate and above

Family education

Educational level	Grand father	Grand mother	Father	Mother	Child		
					I	II	III
Illiterate							
Can read only							
Primary							
Middle							
High school							
Graduate							
Post graduate							

Are you member of any political, social, rural or cultural organization ?

- (i) Member of no organization
- (ii) Member of one organization
- (iii) Member of more than one organization
- (iv) Office bearer
- (v) Public leader

Type of house

- (a) No house
- (b) Hut
- (c) Kachcha
- (e) Pacca
- (f) Pacca big hosue

14. Material possession

What are the materials do you possess out of the following ?

(a) Agricultural implements

Item	No. of article	Item	No. of article
1. Disc harrow		1. Iron plough	
2. Winnower		2. Harrow	
3. Leveler		3. Toka (power)	
4. Ridger		4. Duster	
5. Planker		5. Sickles	
6. Tractor trolley		6. Hoes	
7. Diesel pump set		7. Trifali	
8. Cultivator		8. Roller	
9. Trailer		9. Bullock cart	
10. Seed drill		10. Chaff-cutter	
11. Sprinkler		11. Sprayer	
12. Desi plough		12. Baskets	
13. Thresher		13. Spades	
14. Other specify			

(b) Domestic items

Item	No. of article	Item	No. of article
1. Stove		Electric press	
Grind stove		Emerson Rod	
Iron		Gobar gas plant	
2. Bread toaster		Mixi	
Egg beater		Electric kettle	
3. Gas		6. Cooking range	
Milk boiler		Electric mill	
4. Electric heater		Refrigerator	
Pressure cooker		Knitting machine	
Rice cooker		Geyser	
Juicer		Coffee perculator	
Sewing machine			

C. Transportation and communication means

Sl. No. Items	No. of articles
1. Car	
2. Motor cycle	
3. Moped	
4. Bicycle	
5. Telephone	
6. Television	
7. Tape recorder	
8. Radio	

15. Farm experience

How much experience you have of working on agriculture field ? years

16. Communication variables

A. Information source

(a) Do you learn new things about farming/household plant from happenings and experiences of your village ? Yes/No

(b) Please name the localite source through which you have been receiving information on farming/household

Friends

Neighbours

Village leaders

Relatives

Panchayat members

Any other

(c) Do you learn new things about farming household from govt. or voluntary workers Yes/No

(d) Please name the cosmopolite sources through which you have been receiving information on farming/household ?

KVK worker

Social worker

NGO's

ADO Agriculture

Block

B. Mass media exposure

(a) Do you listen radio Yes/No

(b) Do you listen programmes Yes/No

- (c) If yes, with what frequency ?
 (i) Daily
 (ii) Often
 (iii) Sometimes
- (d) Do you possess TV set ? Yes/No
- (e) Do you watch TV programmes related to farm ? Yes/No
 If yes, with what frequency ?
 (i) Daily
 (ii) Often
 (iii) Sometimes
- (f) Have you visited any exhibition or Mela related to farm ? Yes/No
 If yes, mention the frequency
 (i) Daily
 (ii) Often
 (iii) Sometimes
- (g) Do you read any newspaper ? Yes/No
 If yes, mention the frequency
 (i) Daily
 (ii) Often
 (iii) Sometime
- (h) Do you read any magazine related to farm ? Yes/No
 If yes, mention the frequency
 (i) Daily
 (ii) Often
 (iii) Sometime

C. Extension contact

- | | Always | Seldom | Never |
|-------------------------|--------|--------|-------|
| (i) Meeting | | | |
| (a) Gram Sevika | | | |
| (b) Health visitor | | | |
| (c) BDO/agent | | | |
| (d) KVK | | | |
| (e) Scientist | | | |
| (ii) Visited | | | |
| (a) Field demonstration | | | |
| (b) Kisan Mela | | | |
| (c) Craft centre | | | |
| (d) Mahila Mandal | | | |

PHYSIOLOGICAL VARIABLES

(a) Innovation proneness

	Agreed	Undecided	Non agreed
1. Many new technologies are being talked about but who know if they are better than the old ones.			
2. I feel restless till I try out new technology I have heard about.			
3. I do not see any reason for changing technology used by our forefather.			
4. I will surely adopt new technology if they are successful.			
5. I believe that new technologies are not better than old ones.			
6. I believe that new technologies are better than the old one.			

(b) Risk orientation

	Agreed	Undecided	Non agreed
1. A farm-women should rather take more of a chance in making a big profit than to be content with a smaller but less risky profit.			
2. A farm-women who is willing to take greater risks than the average farm-women usually does better financially.			
3. It is good for a farm woman to take risks when she knows her chance of success is fairly high.			
4. Trying on entirely new technology in home by a farm woman involves risk, but it is worth.			
5. A farm-women should not adopt large number of improved technologies to avoid greater risk involved in those technologies.			
6. It is better for a farm-women not to try new technology under most of the others have used them with success.			

(c) Economic motivation

	Agreed	Undecided	Non agreed
1. A farm woman would work towards improved technology for domestic work and economic profits.			
2. Most successful farm woman is the one who makes the most profit.			
3. A farm woman should try any new home technology idea which may earn her more money			
4. Farm woman should adopt profitable technology to increase monetary profits in comparison to adopting new technology for non profit purpose.			
5. It is difficult for the farm women's children to make good start unless she provides them with economic assistance.			
6. A farm woman must contribute to earn her living but the most important thing in life can not be defined in economic terms.			

Score sheet for judges

(A) Place each statement on a seven point continuum by marking (✓) after judging the degree of relationship it expresses

S.No.	Statement	Very good	Good	Less good	Undecided	Less poor	Poor	Very poor
		1	2	3	4	5	6	7
Statement for the acceptance of biogas								
A. Biogas plant								
(1)	It is better to use biogas as its use can not rebate towards improving public health.							
(2)	Use of biogas can help towards removing the smoke from the kitchen.							
(3)	More time may be required when biogas is used for cooking food.							
(4)	Use of biogas can result in reducing in health hazards.							
(5)	Use of biogas can help in protecting the eyes from the smoke.							
(6)	Biogas may be considered to be less efficient than traditional stove.							
(7)	It seems that use of biogas protects the throat from the smoke.							
(8)	Use of biogas can help in saving the cooking time.							

S.No. Statement	Very good	Good	Less good	Undecided	Less poor	Poor	Very poor
	1	2	3	4	5	6	7
(9) Kitchen utensils may not be blackened by the use of biogas.							
(10) Use of biogas seems to provide better scope for cleanliness in the house.							
(11) Taste of food items cooked in biogas is not acceptable.							
(12) It seems that by the use of biogas women may not have to collect fuel for cooking from outside.							
(13) Food items cooked on biogas may be less nutritious.							
(14) Use of biogas can help in removing the soot from the homes.							
(15) I feel that the technique of promoting environmental sanitation through biogas is a useful technique.							
(16) We get fuel. There is no need to spend money on biogas.							
(17) It seems that by the use of biogas people can free from the mosquitoes.							

S.No.	Statement	Very good	Good	Less good	Undecided	Less poor	Poor	Very poor
		1	2	3	4	5	6	7
(18)	One can cook more efficiently on traditional chulha than on biogas.							
(19)	It is better to use biogas because it saves women from drudgery of cooking..							
(20)	If feel no problem in working on traditional chulha.							
(21)	We can consider biogas as more efficient than traditional cooking devices.							
(22)	I feel biogas is an unnecessary burden.							
(23)	It seems that use of biogas can help in saving of the kerosene oil.							
(24)	All members of my family do not feel good to work with the biogas.							
(25)	The cleaning of biogas is so easy that I can conveniently do without any problem.							
(26)	It seems that biogas can be constructed without any difficulty.							

S.No.	Statement	Very good	Good	Less good	Undecided	Less poor	Poor	Very poor
		1	2	3	4	5	6	7
(27)	It seems that biogas have more problems than benefits.							
(28)	Biogas can provide more employment opportunity to rural poor.							
(29)	I will prefer to use biogas because it helps in fuel conservation.							
(30)	The materials used in this plant are not available under village condition so it is difficult to construct.							
B. Manure production								
1.	It seems that biogas plants provide good manure for farming.							
2.	Biogas slurry as manure can help in getting increased food production.							
3.	Biogas slurry can be considered as better manure than compost.							
4.	Biogas can help me in getting cheaper manure as compared to other manures.							

S.No.	Statement	Very good	Good	Less good	Undecided	Less poor	Poor	Very poor
		1	2	3	4	5	6	7
5.	It seems that biogas manure is free of bad smell.							
6.	Biogas slurry can benefit the soil by increasing its water holding capacity.							
7.	Biogas slurry can benefit the soil by improving its structure.							
8.	It seems that biogas slurry is free of insects.							
9.	We can get manure from biogas plant quickly.							
10.	It seems that the essential nutrients required for the growth of plants and crops are not found in biogas manure.							
11.	If I construct biogas in my house, I am sure I will solve all my waste dung and plant residue problems.							
12.	Use of biogas plant seems to offer ample scope for keeping the environment clean.							
13.	I feel that comparatively more time duration may be required to convert dung into compost by traditional method than biogas plant.							

S.No. Statement	Very good	Good	Less good	Undecided	Less poor	Poor	Very poor
	1	2	3	4	5	6	7
1. For me the process of producing biogas manure is more of a problem than compost.							
2. Use of biogas manure can help in keeping the land to remain formally fertile for two to three years.							
3. It seems that chemical fertilizer remains effective for only one year as compared to biogas manure.							
4. It seems that use of biogas slurry as manure can be hazardous for health.							
5. The growth of plants can be adversely affected when treated with biogas manure.							
6. I feel that the fertility of soil gets spoiled by the regular use of chemical fertilizer.							
7. It seems that the seeds treated with biogas manure are sprouted fastly.							

S.No.	Statement	Very good	Good	Less good	Undecided	Less poor	Poor	Very poor
		1	2	3	4	5	6	7
1.	I feel that installation of biogas plant can increase mis-utilization of dung							
2.	The treatment of biogas manure can help the seeds to be sprouted in large number.							
3.	We may use the upper tile of biogas plant for sitting purpose at time.							
4.	Biogas plant requires more space, so we should not use this.							
5.	I feel that there is greater need for proper disposal of waste dung through biogas.							
6.	Treatment of biogas manure can decrease the ability of plants to fight against diseases.							
C.	Biogas fuel engine							
1.	The use of biogas can help in running motor pump.							
2.	The use of biogas engine can help in ploughing on farms.							
3.	For me biogas engine is an unnecessary burden.							

S.No.	Statement	Very good	Good	Less good	Undecided	Less poor	Poor	Very poor
		1	2	3	4	5	6	7
4.	The use of biogas engine can help in chaff cutting.							
5.	Use of biogas engine requires more skill in which we are lacking.							
6.	Biogas engine can be used for flour milling.							
7.	There are more chance to get this biogas plant out of order so I will not use it.							
8.	It seems that use of biogas engine can help in saving of the diesel.							
9.	I feel that the maintenance of biogas fuel engine is a costly affair.							
10.	By the use of biogas fuel engine, I can save my money labour.							
11.	It seems that by the use of biogas fuel engine I can save my money.							
12.	Use of biogas fuel engine can help in reducing the dependence of villagers on conventional sources of energy.							
13.	To invest labour for construction of biogas plant is a waste.							

S.No. Statement	Very good	Good	Less good	Undecided	Less poor	Poor	Very poor
	1	2	3	4	5	6	7
14. It seems that the use of biogas fuel engine is not a practically useful technology.							
15. It seems that biogas plant can provide much more fuel energy as compared to other sources.							
16. If government provides some training on power generation from biogas plant, I can attend it.							
17. It seems that biogas fuel engine is less efficient than diesel engine.							
18. I feel that adoption of biogas fuel engine can influence family economy in a positive way.							
19. Use of biogas engine can help in solving the energy crises to a great extent.							
20. Though biogas fuel engine is a good technology, the economic situation of most farm-women do not permit the use of it.							
21. There is nothing to hesitate to use biogas fuel engine as it seems to be ideal to use.							

S.No.	Statement	Very good	Good	Less good	Undecided	Less poor	Poor	Very poor
		1	2	3	4	5	6	7
22.	I feel that other sources of power production are more easily available for farm operation than biogas fuel engine.							
23.	The maintenance of biogas engine is so easy that I can frequently take care of its maintenance by myself.							
24.	In my view use of biogas fuel engine for farm operation is costlier than traditional methods.							
25.	It seems that power production from biogas for farm operation is a complex process.							
D. Biogas lighting								
1.	Biogas can be considered as a source of electricity for lighting.							
2.	Biogas lighting is less efficient than traditional source.							
3.	Money spent on kerosene oil can be saved if biogas is used for lighting purpose.							

S.No.	Statement	Very good	Good	Less good	Undecided	Less poor	Poor	Very poor
		1	2	3	4	5	6	7
4.	I feel that the intensity of light obtained from biogas is less.							
5.	If I see any neighbour working with biogas plant I can use it.							
6.	Biogas lighting is an extra burden for me.							
7.	If govt. has some training centres of biogas plant for lighting at village level I can attend it.							
8.	There is no need of lighting from biogas, if I can get this purpose solved by use of other sources.							
9.	By the use of biogas lighting, I can save my money.							
10.	To invest money for construction of biogas for lighting purpose is a waste.							
11.	By the use of biogas lighting, I can save my labour.							
12.	Biogas lighting might be a good technology but the results shown are not always encouraging.							

S.No.	Statement	Very good	Good	Less good	Undecided	Less poor	Poor	Very poor
		1	2	3	4	5	6	7
13.	Biogas may be considered as more economic than conventional source because it pays back the investment of its cost.							
14.	Though the use of biogas for lighting is good the economic situation of most farm-women do not permit the use of it.							
15.	Use of biogas lighting is a boon for everyone.							
16.	The ultimate aim of saving fuel is not achieved by the use of biogas lighting, as I feel.							
17.	Working of biogas lighting is not difficult at all. Therefore, everyone should use it.							
18.	I feel that biogas lighting has more problems than benefits.							
19.	Most farm-women in this area should use the biogas for lighting purpose.							
20.	I feel no problems with the traditional method.							

S.No.	Statement	Very good	Good	Less good	Undecided	Less poor	Poor	Very poor
		1	2	3	4	5	6	7
21.	I feel that having biogas lighting is a symbol of status in the society.							
22.	Use of biogas for lighting purpose can help in energy conservation							



Photo 1: Supervision of Bio-gas plant



Photo 2: Showing light coming through Bio-gas

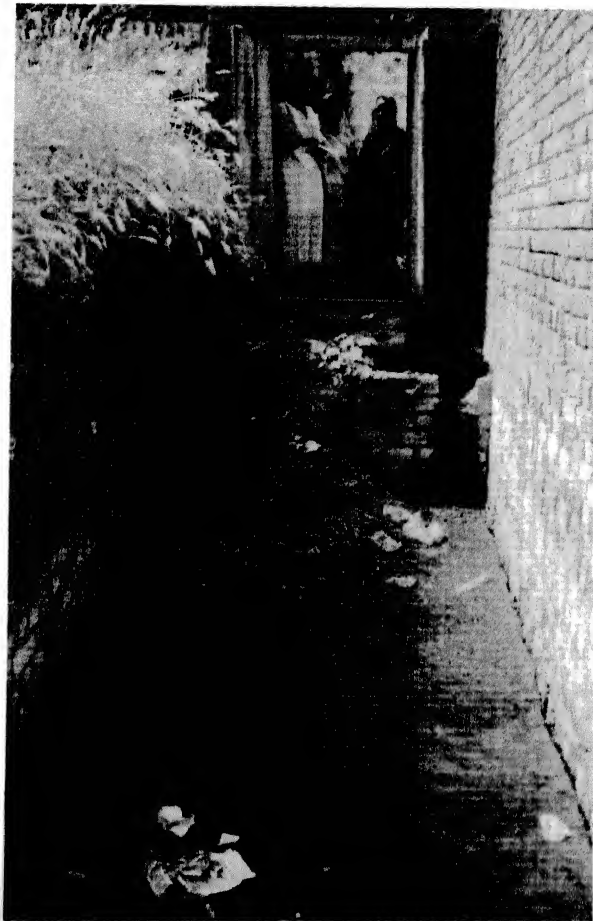


Photo 3: Showing Manure heap used in Bio-gas production



Photo 4: Cooking through Bio-gas



Photo 5: Conversation with BDO, Fatehpur about adoption of Bio-gas by the villagers